



## **Identification of New Agent Orange / Dioxin Contamination Hot Spots in Southern Viet Nam**

Final Report

**January 2006**

***A Project Implemented by 10-80 Division, Ministry of Health, Viet Nam and  
Hatfield Consultants Ltd., West Vancouver, BC, Canada***

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## **DEDICATION**

The project team wishes to dedicate this report to the memory of Professor Hoang Dinh Cau, former chairman of the 10-80 Division, Ministry of Health. Professor Cau dedicated the last 30 years of his professional career to helping the Vietnamese people deal with the consequences of Agent Orange. He was a close ally and colleague of everyone at Hatfield, as well as to many international scientists and researchers. His teachings, congenial manner, friendship and optimism will be missed by all those fortunate enough to have been part of his life.

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We wish to acknowledge the assistance of many Vietnamese who provided information, guidance, logistical support, permits and encouragement during this study. In each province where a former US military base was the focus for study, our team met with local military and Peoples' Committee representatives. To the many individuals, too numerous to mention here, we express our sincere appreciation.

Special thanks are due to the Vietnamese military deminers who swept lands in advance of our soil collections.

To Ms. Lady Borton, a long-time friend of the Vietnamese people, 10-80 Division and Hatfield Consultants, we owe our continuing heartfelt thanks for her tireless efforts, not only on this project, but for the betterment of the lives of the people of Viet Nam.

## EXECUTIVE SUMMARY

This report summarizes the results of an investigation of Agent Orange/dioxin hot spots in southern Viet Nam. These hot spots are located on former US military installations that served as airbases during the Viet Nam conflict. These airbases also served as sites for the activities of Operation Ranch Hand, the US military code name for the herbicide spray program in southern Viet Nam that extended from 1962 to 1971.

The study included a phased approach for the identification of hot spots, where:

- Phase I involved the identification of potentially contaminated sites that may pose a risk to human health; and
- Phase II included confirmation of select Phase I listed sites through a field sampling program, further refinement of the human health risk, and recommendations for future action.

During Phase I, information originating from web-based research, the Vietnamese Ministry of Defense, anecdotal US and Viet Nam veteran's accounts and previous 10-80 Division/Hatfield dioxin sampling programs and reports, was used to identify 18 sites in southern Viet Nam with the highest potential for dioxin contamination, and the highest potential risk to the health of local people. The 18 sites served as the target locations for a field reconnaissance program completed in February/March 2004.

Following field reconnaissance activities, and using data obtained during the survey, seven bases were selected for the Phase II field assessment program: Da Nang (An Don storage facility and Da Nang airfield), Pleiku airfield, Phu Cat airfield, Nha Trang airfield, Bien Hoa airfield, Can Tho airfield, and Tan Son Nhut airfield.

Soil/sediment samples were collected from each of the seven bases in March 2005. Sampling sites were selected downstream of suspected former Ranch Hand operations. It was not always possible to sample directly in the suspected sites, given the limited information on exact location; in some instances, permission was not granted to sample on what was suspected to be the Ranch Hand site.

Some initial soil sampling was undertaken at Phu Cat and Bien Hoa during the reconnaissance visit in 2004. The majority were sampled in March 2005. All samples were shipped to Canada for laboratory analyses at AXYS Analytical Services. A total of 93 soil/sediment samples were processed for polychlorinated dibenzo dioxins and polychlorinated dibenzo furans using high resolution mass spectrometric equipment. Total toxic equivalency for each sample was calculated on the basis of revised toxic equivalency factors set forth by the World Health Organization.

Da Nang, Phu Cat and Bien Hoa airfields were identified as significant hot spots on the basis of dioxin levels recorded in soils/sediments. The remaining airfields sampled at Pleiku, Nha Trang, Can Tho, and Tan Son Nhut are not considered significant hot spots. However, some dioxin data from these aforementioned bases would probably elicit some form of mitigative action by regulatory authorities, if similar dioxin levels were found in certain western jurisdictions.



The significant hot spots of Da Nang, Phu Cat and Bien Hoa exceed soil/sediment guidelines for many western countries/jurisdictions. Bien Hoa had the highest level of dioxin toxicity (833 pg/g TEQ), with a 2,3,7,8-TCDD reading of 797 pg/g (sediment).

Recommended strategies for further evaluation and protection of local populations in each of the significant hot spot areas are presented. These strategies include documentation of contamination of the local food chain and assessment of how contaminated foods may be impacting local Vietnamese populations. Mitigative actions are recommended and required if the local food chains are proven to present a risk to humans, through either direct or indirect contact.

Dioxin guidelines for soil in other countries/jurisdictions were reviewed in the context of levels recorded in Viet Nam. Many of the dioxin concentrations encountered in Viet Nam would trigger some form of regulatory response, if detected in these other jurisdictions. In the development of soil guidelines for Viet Nam, consideration should be given to the close association rural populations have with their land. This fact warrants attention when developing guidelines for soils in residential and agricultural (i.e., food producing) areas – often in rural areas, foods are produced on residential lands.

This study has set the foundation for other programs in southern Viet Nam where there may exist areas of dioxin contamination that pose a threat to human health. Protection of the local population from residual dioxin contamination is of highest priority, particularly in Bien Hoa. Awareness raising campaigns are required to help reduce exposure of local residents to dioxins; plans for eventual clean-up of contaminated sites need to be formulated.

## 1.0 INTRODUCTION

This report summarizes work completed by the 10-80 Division of the Ministry of Health (Government of Viet Nam) and Hatfield Consultants Ltd. for the project entitled “Identification of New Agent Orange/Dioxin Contamination Hot Spots in Southern Viet Nam”. This report is the culmination of over a decade of research (see References, Section 5.0), in which the 10-80 Division and Hatfield Consultants Ltd. proposed and validated the hot spot theory of residual Agent Orange/dioxin in southern Viet Nam. This study further defined additional hot spots. Work was undertaken between October 2002 and December 2005.

## 1.1 BACKGROUND

In 1962, the US military initiated use of herbicides in Viet Nam for general defoliation and crop destruction through a program codenamed Operation Ranch Hand (IOM, 2001). Application of herbicides was primarily through cargo aircraft (C-123s), and ground mechanisms (i.e., trucks, backpack sprayers and riverboats); helicopters were also used in certain areas of the country. Over 72 million litres of herbicide were applied over southern Viet Nam (Westing, 1984; IOM, 1994). Herbicide applications ceased in 1971. However, recent studies reviewing spray records from the war reveal that over 80 million litres of herbicide were used in Viet Nam (Stellman *et al.*, 2003).

Sixty-one percent of the herbicide used in Viet Nam was Agent Orange, a 50/50 mixture of 2,4-dichlorophenoxyacetic acid (2,4-D), and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T). The 2,4,5-T fraction of the Agent Orange mixture contained the highly toxic chemical 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) (Dwyer and Flesch-Janys, 1995; IOM, 2001). The presence of the TCDD dioxin congener in Agent Orange was initially unknown to the US military; however, this position has been challenged by a leading US military figure involved in the war. Zumwalt (1990) stated that dioxin in the Agent Orange mixture was, in fact, known to the military when use of herbicides in Viet Nam was initiated in the 1960s.

Military installations throughout southern Viet Nam (e.g., Bien Hoa, Da Nang, Nha Trang, and Phu Cat) served as bulk storage and supply facilities for Agent Orange (US Army documents, 1969; Cecil, 1986). These storage sites experienced spills of herbicide. In 1970, for example, a 7,500 US gallon spill of Agent Orange occurred on the Bien Hoa base; between January and March 1970, three other spills of lesser volume occurred at Bien Hoa (US Army documents, 1970).

As a consequence of the aerial applications and handling of Agent Orange on military installations, there exist two primary sources of major TCDD contamination in Viet Nam – from spray missions by C-123 aircraft, and contamination on former US military installations where herbicide was stored, dispensed, and spilled. Herbicide applications also occurred in Lao PDR (Laos) and Cambodia, although less is known of the impacts to the environment and human populations in these countries.

10-80 Division and Hatfield Consultants Ltd. (Hatfield) examined the environmental consequences of aerial applications and use of Agent Orange at military bases from 1994-2001 in the Aluoi District (the Aluoi Valley) of central Viet Nam (Hatfield Consultants and 10-80 Committee, 1998, 2000; Dwernychuk *et al.*, 2002). The valley is situated approximately 65 km west of Hue, in Thua Thien Hue Province. A summary of the key findings of these studies is provided below.

The Aluoi Valley was an integral portion of the Ho Chi Minh Trail, given its proximity to the former demilitarized zone (DMZ) between North and South Viet Nam. The valley had three US Special Forces bases and was extensively sprayed with Agent Orange between 1965 and 1970. Aluoi and Ta Bat Special Forces bases were closed in 1965, being operational for less than one year. The A So base (formerly known as the A Shau Special Forces base) remained operational from 1963 to 1966 (Stanton, 1985). Defoliants were used and stored on the A So base during its operation (US Army documents, 2001).

The Aluoi Valley was selected by Hatfield and the 10-80 Committee to evaluate the long-term environmental consequences of Agent Orange use to facilitate extrapolation to other regions of southern Viet Nam. The investigations focused on determining where the highest levels of TCDD contamination may exist – on lands sprayed by C-123 aircraft, and/or on former US military installations where use/misuse of herbicides occurred. (Hatfield Consultants and 10-80 Committee 1998, 2000).

Sites where dioxin levels are found to be high may be categorized as Agent Orange/dioxin ‘hot spots’ (Dwernychuk *et al.*, 2002). The study focused on an environmental component of the Aluoi Valley, soils, as a key medium for defining primary hot spots. Given that soil contamination in the Valley is the precursor to present-day food chain and human contamination, it follows that dioxin levels in soil be used as the principal factor defining a hot spot.

TCDD levels in the soils of the three former Special Forces bases were elevated when compared to soils from areas of the Aluoi Valley that received aerial applications of Agent Orange. The highest TCDD levels were recorded at the A So base, 897.85 pg/g (Total I-TEQ, 901.22 pg/g; Dwernychuk *et al.*, 2002).

Aluoi and Ta Bat Special Forces bases were used for less than one year, while A So was operational for approximately three years. Even though the two short-lived bases did not experience on-site military activity as long as A So, TCDD contamination was generally higher than that measured in soils along the valley bottom where aerial applications of Agent Orange had occurred. Soil TCDD levels on the Aluoi base ranged from 5.0 pg/g to 19 pg/g; on the Ta Bat base, 4.3 pg/g to 35 pg/g (Dwernychuk *et al.*, 2002).

The Total I-TEQs of soils, particularly those from the former Aluoi Valley bases, reflected the high contribution of TCDD to the Total I-TEQ calculation (approximately 83% to >99% TCDD contribution to Total I-TEQs). These high percentages strongly indicate that Agent Orange was the origin of TCDD contamination in the region.

The highest TCDD levels along the portion of Aluoi Valley, sprayed by C-123 aircraft, was 15 pg/g (Total I-TEQ, 17 pg/g). Other values along the valley bottom ranged from non-detect (ND) to 7.9 pg/g.

10-80 Division and Hatfield theorize that the pattern of TCDD contamination recorded in the Aluoi Valley serves as a model for contamination throughout southern Viet Nam (Dwernychuk *et al.*, 2002). Human exposure, and subsequent contamination through the food chain transfer of TCDD, is expected to be highest in areas of former military installations where significantly higher concentrations of TCDD may be residing in soils, particularly as a result of herbicide spills. Soils in regions aerially sprayed would not be expected to have the same loading of Agent Orange, and therefore TCDD, as military bases.

Schechter *et al.* (2001) sampled near the former Bien Hoa base, and measured extremely high levels of TCDD in soils (e.g., 1,164,699 pg/g dry weight) and in human blood (e.g., 271.1 pg/g lipid). These levels are probably related to the Agent Orange spill at Bien Hoa in 1970 (US Army documents, 1970), particularly when considering that the soil TCDD contributed 99% of the toxicity to the Total I-TEQ; for blood, TCDD contributed 92% of the Total I-TEQ for the 271.1 pg/g sample. Additional studies near Bien Hoa have recorded a blood TCDD level of 413 pg/g lipid (Schechter *et al.*, 2002). Schechter *et al.* (2001) reported 2 pg/g TCDD in pooled blood from a Ha Noi control group. These data further strengthen our theory that the key hot spots are located near former military installations.

Studies in the vicinity of the former A So US military base demonstrate that TCDD contamination has spread from soils to humans via the food chain (Dwernychuk *et al.*, 2002). The soil medium is the ultimate reservoir/source of TCDD, and thereby warrants the term 'primary hot spot'. The fact that foods, human blood and breast milk in the A So commune were also found to have the highest dioxin content generates additional concerns related to nutritional and public health issues. These additional "hot spot strata" (i.e., food and humans) are a direct consequence of the mobilization and migration of TCDD from soil through foods into humans. Results from the Aluoi Valley study emphasize that former US military bases should be the primary sites on which to concentrate further studies and direct remediation measures, thereby helping reduce potential TCDD exposure for local Vietnamese populations.

## **1.2 RATIONALE FOR PROJECT**

During the Viet Nam conflict, the US and south Vietnamese military established numerous military installations throughout southern Viet Nam (e.g., artillery bases, communication bases, etc.), as well as in Laos and Cambodia. Use and storage of Agent Orange on these facilities occurred (US Army documents, 1969, 1970). Ranch Hand spray missions were supplied herbicides from bulk storage facilities (Cecil, 1986). The storage areas for herbicides experienced spills, which prompted recommendations addressing these occurrences (US Army documents, 1969). Recommendations regarding the handling of Agent Orange on storage/dispensing

facilities included the construction of drainage ditches, spill ponds, and systems comparable to septic field distribution for spilled herbicides. These protocols were probably in place at many of the Agent Orange storage centres.

The issue of suspected dioxin reservoirs or “hot spots” has been raised over the years in Viet Nam, tied to the use of Agent Orange by the US military. Dwernychuk *et al.* (2002) demonstrated that these reservoirs, or “hot spots”, exist in soils of former US military installations, are contaminating local food chains, and are contaminating humans that consume foods produced in these affected regions.

Protection of the human food supply from contamination by toxins, including dioxins, is of paramount concern throughout the developed world. A “standards/guideline” approach to human health protection has been taken to address the dioxin issue in many western jurisdictions. Numerical standards and guidelines addressing TCDD contamination have been established by many reputable organizations and scientists (e.g., WHO/EURO 1988, 1989, 1991, 1998a, 1998b, 2001; Agency for Toxic Substances and Disease Registry 1997, 1998; International Agency for Research on Cancer [a division of the World Health Organization] 1997). When these contamination guidelines are exceeded in soils or human food, mitigation action is recommended and/or enforced.

10-80 Division/Hatfield believe a similar “standards-based” approach should be taken in Viet Nam. However, western standards are likely not conservative enough, given that most rural people in Viet Nam (particularly ethnic minority groups), live in close contact with the soil (i.e., dirt floor housing, children playing in and ingesting contaminated soil), and depend on locally produced food sources (e.g., fish/ducks).

The research by 10-80 Division/Hatfield (Hatfield and 10-80 Committee 1998, 2000; Dwernychuk *et al.* 2002) has shown unequivocally that hot spots do exist and that dioxin contamination is:

- not an historical problem, but occurring to this day in many areas of Viet Nam; and
- adversely affecting the health of those people living in the vicinity of/on dioxin hot spots.

The principle dioxin reservoirs, or hot spots, that were tentatively identified by Dwernychuk *et al.* (2002) included:

- former warehouses and Agent Orange spray-plane loading stations (spills, leaks, etc.) such as Bien Hoa and Da Nang;
- Agent Orange spray-plane crash sites;
- jettison sites (loads dumped because of mechanical or weather difficulties);
- former air strips (repeated truck and hand-held spraying);

- perimeters of former military bases (repeated truck and hand-held spraying); and
- topographical low spots (basins) where dioxin has concentrated in run-off sediment.

10-80 Division/Hatfield studies in the Aluoi Valley, in addition to recent work at the Bien Hoa airbase (Schechter *et al.* 2001, 2002), have verified that former military installations are priority areas for toxic contaminant surveys. Dwernychuk (2005) also emphasized that research and mitigation measures should focus on dioxin hot spots near former US military installations in southern Viet Nam.

10-80 Division and Hatfield have demonstrated that aerially sprayed regions of the Aluoi Valley do not retain high levels of TCDD, given years of tropical rains, erosion, chemical breakdown, and other environmental factors. However, areas of concern include those where Agent Orange and other defoliants were spilled, loaded onto aircraft, applied by truck-mounted sprayers, or transported. The resultant dioxin loading to soils near former military installations was significantly higher than that resulting from aerial applications, and continue to exist as dioxin hot spots or dioxin reservoirs to this day (Dwernychuk, 2005).

The Ford Foundation funded project entitled “Identification of New Agent Orange Dioxin Contamination Hot Spots in Southern Viet Nam” was initiated following the recommendations from earlier research of 10-80 Division and Hatfield (and others). Given the large number of former military bases and wide extent of aerially sprayed regions of southern Viet Nam, there was a critical need for identification of other hot spots, in addition to those described in past research.

10-80 Division/Hatfield recommended a phased approach to hot spot studies, which would provide a systematic and practical way to deal with chemical contamination issues in Viet Nam. The first two phases were designed to identify chemical reservoirs/hot spots and assist/educate local people to minimize further contamination. The priority was to identify high risk groups, such as children and pregnant/nursing women, who may be exposed to elevated levels of dioxins resulting from their proximity to contaminated hotspots. Therefore, the assessment used in this project to identify suspected contaminated sites was formulated on a risk-based evaluation process.

The project plan included a phased approach to the assessment where:

- **Phase I** involved the identification of potentially contaminated sites (hot spots) that may pose a risk to human health; and
- **Phase II** included confirmation of Phase I listed sites, further refinement of the human health risk, and development of mitigation strategies for those sites that pose an unacceptable risk to human health.

Information collected during Phase I was used to formulate a risk-based assessment of dioxin contaminated hot spots, guiding the Phase II field sampling efforts intended to better define and validate dioxin contamination at those locations. This report provides a summary of both the Phase I and II work undertaken.

## **2.0 METHODS**

### **2.1 SITE ASSESSMENT APPROACH TO THE HOT SPOT PROJECT**

The guiding principle of “healthy land, healthy people” for this project is based on the protection of human health, public welfare and the environment. The general methodology selected for the herbicide contaminated site assessment is based on the American Society for Testing and Materials (ASTM, 1995) Standard E-1739 “Standard Guide to Risk-Based Corrective Action (RBCA) at Petroleum Release Sites”. Although this methodology was developed for hydrocarbon contamination, the RBCA process is an effective way of combining site characterization, risk management and remedial action in any contaminated site assessment (NFESC 1998). In particular, RBCA is a cost-effective methodology well suited to address large-scale contaminated site investigations like those required for the Hot Spot Project, with the ultimate goal of returning the land to beneficial use.

#### **2.1.1 Risk-based Site Evaluation**

Decisions regarding allocation of resources to investigation and management of contaminated sites should reflect the risk to human health. RBCA ensures that agencies or personnel responsible for site investigations and management work in partnership with down-stream landuse stakeholders to make site-specific clean-up decisions based on protection of human health; these are determined through a risk-based decision making process, based on future land use and preferred mitigation/remediation strategies (MPCA 1998).

A risk-based approach to contaminated site assessment and management includes the following principles (MPCA 1998):

- Decisions regarding site management should be based mainly on mitigation of unacceptable risks to human health, while realizing the inherent uncertainty in the assessment of risk;
- Site assessment activities and risk-based decisions should focus on collecting only that information required to determine the likely health impacts associated with the site;
- Where the risk to human health or the environment is considered unacceptable, a range of risk mitigation strategies should be considered. The selection of site management options should be based on the ability of the proposed strategy to minimize the risk to human health, the certainty with which the strategy can be implemented, and the cost of implementation;
- If resources available for site management are limited, there is a need to appropriately allocate resources based on the risk to human health; and
- Immediacy of action at a site should reflect the degree to which human health is at risk and the timeframe within which they may occur.

This integrated approach also incorporates factors other than human health with regards to investigation and management actions for contaminated sites. For example, environmental constraints/impacts, legal liability, public/market perception, personal/national security and economic considerations can greatly influence contaminated site evaluation programs (NZMoE 1999). In order to streamline and quantify the assessment and management of risk at individual sites, a tiered approach to site assessment is used.

## **2.1.2 Tiered Approach**

The tiered approach represents increasingly complex risk exposure scenarios requiring increasing levels of site-specific evaluation. Starting with a simple, low cost assessment of risk, tiering precedes to increasingly more complex and detailed approaches to the assessment of risk, as warranted by the risk posed and the cost of site management. Similarly, the resources required and costs associated with each step of the tiering process also increase. For this project, the overall site assessment process, incorporating a risk-based approach to decision making, is summarized below.

### **2.1.2.1 Baseline Assessment**

The initial or baseline assessment, usually a 'desk-top' exercise, identifies potentially contaminated sites that may require investigation and/or remediation. Key information collected during the initial assessment includes site identification, site classification, and a minimum set of existing data that allows the site to be evaluated through the risk-based evaluation process. After being evaluated during the initial assessment, a site either meets the acceptable risk criteria (removing it from further examination) or requires more investigation under a Tier 1 Assessment.

### **2.1.2.2 Tier 1 (Phase I)**

The Tier 1 assessment involves further investigation into sites that, through the initial assessment process, were deemed to potentially pose a risk to human health. Tier 1 uses a set of acceptance criteria to assess whether or not a given site does or does not pose a potential risk to human health. The acceptance criteria are based on a number of variables including: possible contamination levels, human receptors, potential exposure pathways, future land use, ecological factors and physical site characteristics (i.e., geology and hydrology). Depending upon the amount of existing knowledge for a given site, Tier 1 investigations may just be an extension of the Initial Assessment data gathering, or they may include simple preliminary field investigations (e.g., soil sampling program).

Exceeding Tier 1 criteria does not imply the actual risk posed by a site is unacceptable; rather, it indicates that further investigation and site-specific evaluation may be required. When the contaminant characterization at a site does not exceed the Tier 1 acceptance criteria, no further action is required. If Tier 1 acceptance criteria are exceeded, risk-based site management will either:



- require a strategy to mitigate risk by eliminating exposure routes and/or reducing chemical concentrations to acceptance criteria levels; or
- proceed to Tier 2 assessment, which will define more site-specific acceptance criteria.

#### **2.1.2.3 Tier 2 (Phase II)**

The Tier 2 assessment involves the development of site-specific acceptance criteria that are a further refinement of Tier 1 criteria. The Tier 2 criteria are based on site-specific information and/or current and future land use goals (e.g., soil contaminant levels and human exposure to those soils). To achieve a better understanding of site-specific exposure pathways and human health risk, the sampling and analysis of a wider array of media (i.e., environmental, food, human tissue) may be required under the Tier 2 program.

Sites where the potential risk to humans do not exceed Tier 2 criteria will not require further investigation or remediation, but may require monitoring should there be unpredicted changes in contaminant levels and/or land use. If a Tier 2 assessment indicates the presence of a significant risk to human health or the cost of risk management strategies needs further detailed consideration, a Tier 3 evaluation is required.

#### **2.1.2.4 Tier 3 (Phase III)**

A Tier 3 assessment involves site-specific documentation of exposure pathways, human health risk scenarios, and the extent of contamination. The Tier 3 assessment may also include additional sampling of items to better define and characterize site conditions. The outcome of the Tier 3 is the development of a site-specific management plan that outlines target contaminant and appropriate mitigation and remediation methods to achieve those levels. The Plan should also provide a post-remediation monitoring and assessment component, to ensure that the target levels either continue to be met, or are adjusted as site conditions change.

The goal of contaminated site assessment is to minimize and manage the risk to human health. The risk-based, tiered approach is a cost-effective and flexible assessment method that allows decision making to be appropriately tailored to site-specific conditions and hazards, while providing a framework for effectively allocating funding and resources (MPCA 1998 and NZMoE 1998).

### **2.1.3 Application of the Tiered Approach to the Hot Spot Project**

The tiered approach to risk-based contaminated site assessment for the Hot Spot Project is illustrated in Figure 2.1. This decision-making process provides an efficient means of distilling a large number of potentially contaminated sites to a manageable number of key sites that pose the greatest threat to human health in southern Viet Nam.

## 2.2 INFORMATION COLLECTION AND REVIEW

Commencing in November 2003, Phase I data collection activities involved sourcing documents, maps, photographs and satellite imagery that serve as important summaries of historical military activities/installations throughout southern Viet Nam. From these information sources, tabulations of potential hot spots were derived through an elimination process, based on specific criteria unique to each level of evaluation or assessment. In February/March 2004, a field scoping exercise was carried out at locations in southern Vietnam, determined by pre-field ranking (Tier 1 evaluation), to be 'most likely' contaminated and a possible risk to human health.

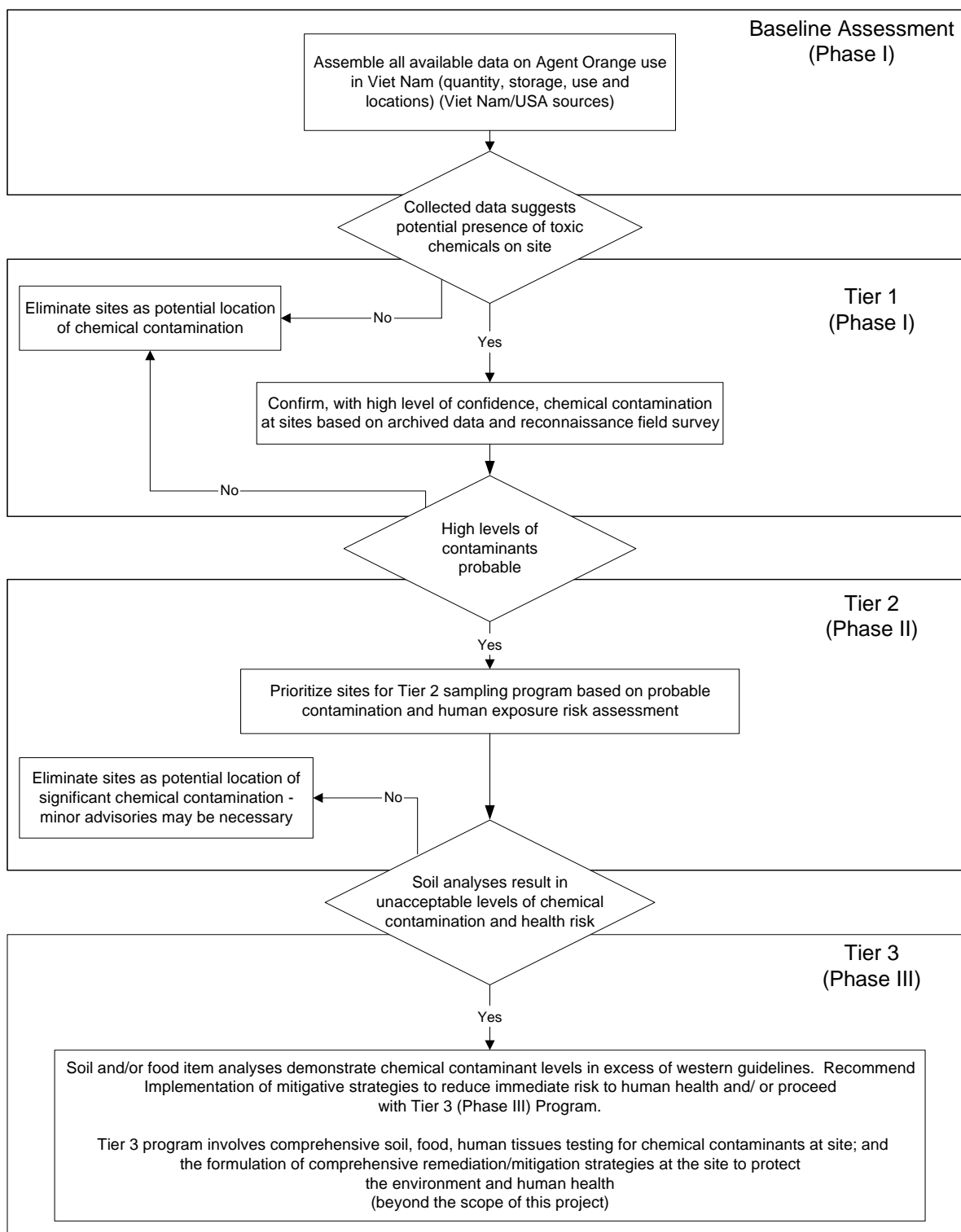
## 2.3 PHASE I: BASELINE ASSESSMENT

For the Hot Spot Project, the first step for site identification and classification included a review of military installations and activities during the US/Vietnam War. The publication *Where We Were in Viet Nam* (Kelley, 2002) provided baseline information (including location, purpose and history) for all US military installations in Southeast Asia during the US/Viet Nam conflict. A total of **16,183** US military installations were identified in *Where We Were in Viet Nam* during the Viet Nam conflict; of these, **2,735** included airbases, airfield, depots, heliports, army bases, airstrips and landing zones (Table 2.1) in southern Viet Nam (therefore, not including sites in northern Viet Nam, Laos and Cambodia).

**Table 2.1** Number and type of US/ARVN military installations that may have been used for the US herbicide program in southern Viet Nam (1961-1971).

Military Installation	Number
Airbase	7
Airfield	599
Supply Depot	11
Heliport	281
Base	219
Area base	12
Base Camp	58
Airstrip	14
Landing Zone	1534
Total	2735

**Figure 2.1 Decision tree for identification of dioxin hot spots in southern Viet Nam.**



Further distillation resulted in a list of **133** southern Viet Nam military sites, based on whether or not the sites met the following criteria:

1. Storage of chemicals;
2. Military airbases;
3. Dumping area and/or buried chemicals;
4. Herbicide aircraft crash sites;
5. Military base camps;
6. Topographical low spots in heavily sprayed areas; and
7. Areas with populations suspected of having high rates of dioxin-related illness.

A total of **28** potential hot spots were selected from the 133 sites based on further web-based research, discussions with the Vietnamese Ministry of Defense, Vietnamese Defense Ministry Reports, anecdotal US and Viet Nam Veteran accounts, previous 10-80 Division/Hatfield dioxin sampling and reports, and Government of Viet Nam sampling data. The list of 28 sites is provided in Table 2.2.

**Table 2.2 Sites with potentially high dioxin contamination in southern Viet Nam.**

No.	Site Name
1	Nhon Co Airfield
2	Long Binh Depot Heliport
3	Bien Hoa Airfield
4	Bien Hoa (Spartan) Heliport/ Bien Hoa Heliport/ Long Binh Ammo Supply Heliport
5	Xuan Loc City Airfield/ Xuan Loc Airfield
6	Qui Nhon Army Depot
7	Long My Depot
8	Phu Cat 2 Airfield
9	Nui Ba Ra Airfield
10	Pleiku Area Airfield/ Pleiku Airfield
11	Pleiku POL Depot/ Pleiku Storage Depot
12	Nha Trang Navy Base/ Nha Trang Naval Facilities
13	Tan Canh Airfield/ Dak To, Tan Canh Airfield
14	Phan Rang Airfield
15	Tuy Hoa North Airfield
16	Tuy Hoa South Airfield
17	Chu Lai Airfield
18	A Shau Airfield
19	Phu Bai Army Airfield/ Phu Bai/ Hue Airfield
20	Tan Son Nhut Airbase
21	Da Nang Army Depot
22	Da Nang Harbour
23	Da Nang/Marble Mountain Airfield / Da Nang Airfield / Da Nang Heliport
24	Khe Loi Lake dump site
25	Ta Con Airfield
26	Song Be/Nui Ba Ra Airfield
27	Can Tho Airfield
28	Bac Lieu Airfield

Subsequent to a further review, a total of **18** reconnaissance sites were selected from the 28 tentative sites on the basis of highest risk to human health, and accessibility of the site. Criteria for this selection included **highest population density near the highest suspected contaminated sites, the ability to locate given sites and permission to visit each area**. The list of 18 reconnaissance sites provided in Table 2.3 formed the target for the field reconnaissance exercise (Tier 1 Assessment) completed in February/March 2004.

**Table 2.3 List of 18 potential dioxin contaminated sites selected for Tier 1 field reconnaissance activities.**

No.	Site Name
1	Chu Lai Airfield
2	Da Nang/Marble Mtn. Airfield
3	Da Nang Army Depot
4	Long Binh Depot Heliport
5	Dak To, Tan Canh Airfield
6	Phu Cat 2 Airfield
7	Long My Depot
8	Qui Nhon Army Depot
9	Pleiku Airfield
10	Pleiku Area Airfield
11	Pleiku POL Depot
12	Pleiku Storage Depot
13	Tuy Hoa North Airfield
14	Tuy Hoa Airfield (south)
15	Nhon Co Airfield
16	Nui Ba Ra Airfield
17	Phan Rang Airfield
18	Nha Trang Navy Base

## 2.4 PHASE I: TIER 1 ASSESSMENT

The key tool for refining risk evaluation under the Tier 1 assessment is the field reconnaissance survey. Field reconnaissance surveys allow for an 'on-site' evaluation of factors that may influence further selection of a site for Tier 2 assessment, and that cannot be ascertained through 'desk-top' research activities. As outlined in the discussion of Risk-Based Site Evaluation, such factors may include site specific hydrology/geology, present land use, human interaction with the site, and site access, all of which impact the ability to design and conduct a meaningful sampling program. The field reconnaissance survey provides additional information that directs further research efforts, and influences the selection process for sites to advance to the Tier 2 or Phase II assessment level.

### 2.4.1 February/March 2004 Field Reconnaissance Survey

Field reconnaissance survey activities for the Hot Spot Project were conducted from February 20 to March 14, 2004. The survey, utilizing two 4WD trucks, traveled the road and highway networks of southern Viet Nam, covering a total distance of over 4,500 km. The field crew involved in reconnaissance activities included participants from 10-80 Division and Hatfield.

The amount and type of data collected during field reconnaissance activities varied from site to site. A field reconnaissance site form (Appendix A1) was filled out for each site visited; however, the information available at each site, and observations made were limited by access, knowledge of provincial, district or commune authorities, willingness of local inhabitants to participate in informal discussions, and localized physical conditions (e.g., ground cover type).

A key factor that influenced the field reconnaissance survey (and also influenced the development of a Tier 2 sampling program) was site access. The degree to which field reconnaissance activities were allowed to proceed was dependent upon the present local sensitivities and activities in the area of interest. For each area visited, official permission from the Provincial Ministry of Defense and Peoples' Committee (both Provincial and Commune level) was required. The degree to which field reconnaissance activities were affected varied from 'not allowed to visit an area', to 'allowed to visit but not allowed to photograph', to 'full access allowed'. At the provincial level, officials evaluated each site independently as to their level of 'sensitivity' prior to our visit, stipulating which activities could and could not be possible.

Field activities included an on-going review of sites chosen for field reconnaissance, as some sites were eliminated due to access and/or permission issues. Others sites were added through consultation with local officials and further historical data research carried out in the field. This continuing process resulted in the list of 18 sites originally chosen for the field scoping exercise being further refined to comprise the sites listed in Table 2.4.

Table 2.5 provides a list of additional areas of interest with regard to possible herbicide/dioxin contamination; however, access limitations prevented field survey activities during the Tier 1 Assessment. Figure 2.2 illustrates the general locations of sites visited during the field survey, and key sites not visited during the field reconnaissance.

**Table 2.4 Areas visited during the February/March 2004 field scoping exercise.**

Administrative Area	Site Name	# of sites	Date Visited
Da Nang City	An Don Storage Facility, Tien Sa Port Facility, Marble Mountain Airfield, Around Da Nang Airport	4	Feb. 22, 2004
Quang Nam Province	Chu Lai Airfield	1	Feb. 23, 2004
KonTum Province	Dak To 1 and Dak To 2	2	Feb. 25, 2004
Gai Lai Province	Pleiku area, Bien Ho Lake and Ia Bang Commune	3	Feb. 27, 2004
Binh Dinh Province	Around Phu Cat Airfield and CK52 Storage Depot	2	Feb. 29, 2004
Phu Yen Province	Around Tuy Hoa South Airfield	1	Mar. 2, 2004
Khanh Hoa Province	Around Nha Trang Airfield, Around Cam Ranh Airfield, Around Dong Ba Thin Airfield	3	Mar. 4, 2004
Dong Nai Province	Around Bien Hoa Airfield, Around Long Binh Depot	2	Mar. 9, 2004
Can Tho City	Around Can Tho Airfield	1	Mar. 12, 2004
Binh Phuoc Province	Around Ba Ra Airfield	1	Mar. 13, 2004
<b>Total</b>		<b>20</b>	

**Table 2.5 Key areas of herbicide dioxin contamination not visited during the February/March 2004 field scoping exercise.**

General Area	Site Name
Gai Lai Province	Pleiku Airport
Ho Chi Minh City	Tan Son Nhut Airport
Ninh Thuan Province	Phan Rang Airbase

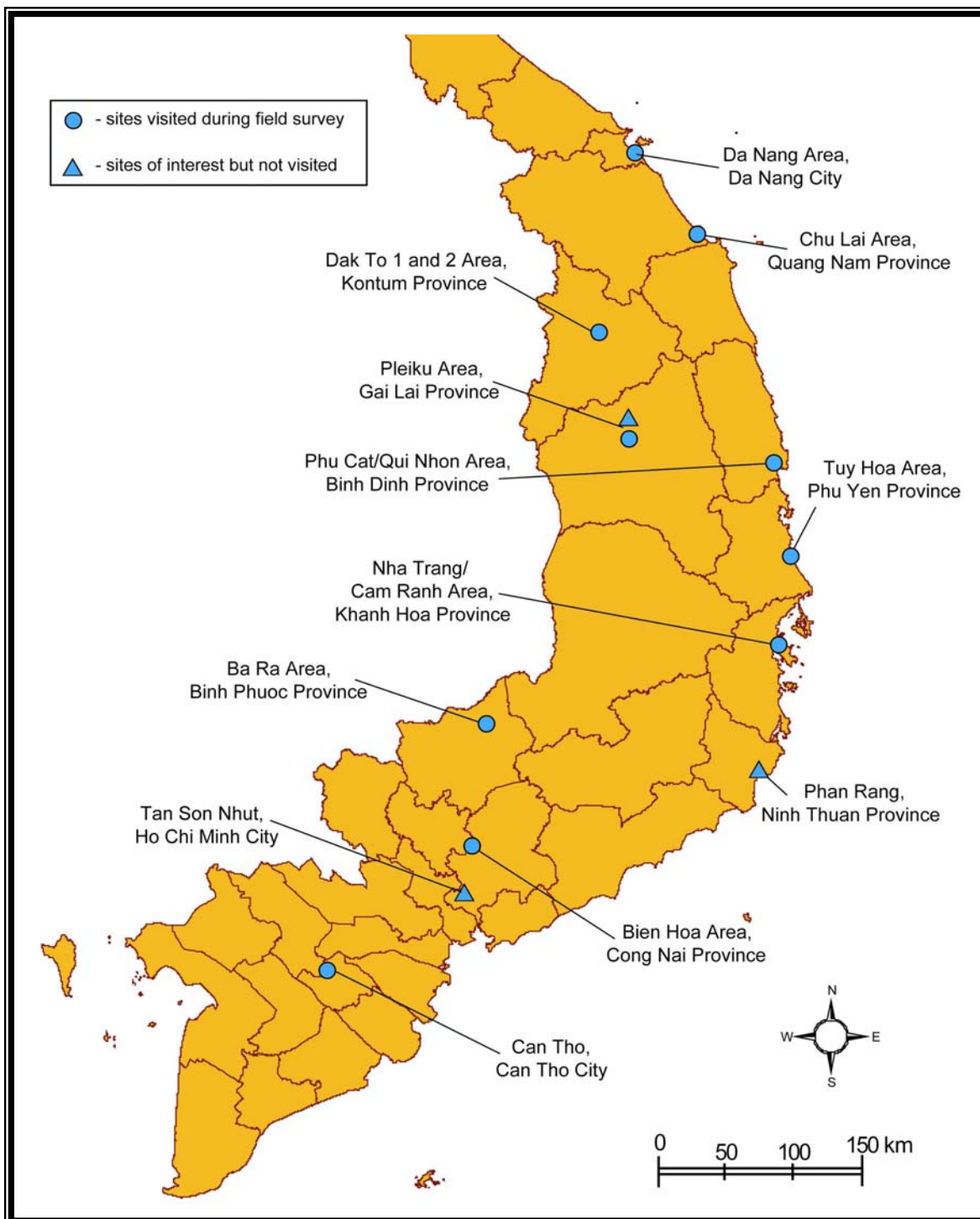
## 2.4.2 Field Reconnaissance Site Summaries

The site summaries are a result of a combination of data collected during our Initial Assessment and Tier 1 field reconnaissance surveys. This information provides the basis for the Tier 1 Evaluation or Ranking of sites as to their relative risk to human health.

### 2.4.2.1 Da Nang City

Four sites within the Da Nang City boundary were visited on February 22, 2004. These areas included An Don ARVN Storage site, Tien Sa Port Facility, Marble Mountain Airfield and the lake/wetland area of the city directly downstream of the northeast corner of the Da Nang Airfield.

**Figure 2.2** Areas chosen for scoping after initial database research of former US and ARVN military installations in southern Viet Nam.





- **An Don Storage Facility:** This ARVN Storage facility was used for short term herbicide drum storage and transfer. Herbicide drums were brought to An Don from the port facility where they were subsequently loaded onto smaller trucks for transport to Da Nang Airfield. The area is currently being developed for commercial/residential use and has had recent infrastructure improvements to road and power facilities. One side of the site is within 200 m of a moderately dense population area with heavy industry occupying other areas around An Don.

*Tier 1 Evaluation:* Presently no confirmed contamination, however, suspected risk due to herbicide storage/transfer site and future residential development. **(Selected for Phase II assessment.)**

- **Tien Sa Port Facility:** This area was used to offload herbicide drums for transfer to the An Don Facility. It is a highly industrialized area and was most likely used for short-term storage of herbicide drums (although not verified). Population density is low with very few nearby residential buildings. The facility is located between a steep mountain slope and the ocean with little evidence of possible contaminant sinks (i.e., ponding or wetland areas).

*Tier 1 Evaluation:* Presently no confirmed contamination; considered low risk due to steep topography and low population density.

- **Marble Mountain Airfield:** Areas around this airfield are also highly industrialized. A steel fabrication plant is now located at what was once a large storage facility for the airfield. The airfield itself is presently occupied by the Vietnamese military and still contains the historic petroleum, oil and lubricants (POL) facility at the south end. Although population density is presently low, a new hospital is under construction across the road from the POL facility. The presence of herbicide at Marble Mountain Airfield was not confirmed during pre-field or field investigations; Marble Mountain was not listed as an Operation Ranch Hand site.

*Tier 1 Evaluation:* Presently no confirmed contamination, however, considered as a suspected risk due to herbicide use often associated with perimeter defenses of major airbases, and possible plans for increased population density in future.

- **Wetland areas northeast of Da Nang Airfield:** Once a wetland area, this area is now home to a commercial/residential community. Run-off from the highly contaminated Operation Ranch Hand site, located at the northeast corner of the Da Nang Airport area, flows out of the airport boundary and into a newly developed lake/park area in the centre of a commercial/residential area. Exact locations of inlet and outlet points were identified, but to what degree the ditches are open for public access was unclear. Inhabitants were observed fishing in the lake during the field reconnaissance visit.

**Tier 1 Evaluation:** Highest risk group due to anecdotal information regarding high dioxin contamination, and a direct pathway to an identified dense population area. **(Selected for Phase II assessment.)**

#### 2.4.2.2 Quang Nam Province

The area around Chu Lai Airfield in Quang Nam Province was visited on February 23, 2004.

- **Area around Chu Lai:** Chu Lai is presently being upgraded to act as an airfreight/cargo center for Viet Nam. Intensive road and infrastructure work is underway including upgrading of the nearby port facility. Chu Lai was a major US Air Force facility during the war, but was not a Ranch Hand site; herbicide associated equipment was not found when North Vietnamese Army (NVA) took over base operations in the mid 1970s. However, NVA personnel recounted the discovery of large amounts of ammunition/CS (o-Chlorobenzylidene Malonotrile; riot control gas crystal) barrels found in a series of bunkers located at the east end of the base. There is a major UXO/landmine/CS problem within the base, confounding the recent base upgrade activities. Soil is primarily sand with little in the way of possible contaminant pathways to nearby populations. Other than military personnel, no inhabitants have been allowed access within the base boundary.

**Tier 1 Evaluation:** Presently no confirmed contamination, however, considered as a suspected risk due to herbicide use (which was often associated with perimeter defenses of major airbases), and possible plans for increased population density in future.

#### 2.4.2.3 Kontum Province

Areas around both Dak To 1 Airfield and Dak To 2 Airfield were visited in Kontum Province on February 25, 2004. Kontum Province experienced intense fighting during the American War. Subsequently, large areas of Kontum (transportation routes in particular) received repeated doses of herbicides from the C-123 spray planes stationed at Phu Cat and Pleiku. Both Dak To 1 and 2 are located immediately adjacent to Highway 14.

- **Dak To 1:** Dak To 1 is a fairly small, older airfield that is presently used as a log storage/sorting area by the local military. The runway is bordered by a rubber plantation to the north and a small cemetery and roadway to the south. Population density is very low. Pre-field assessments did not reveal the use or storage of herbicide at this site. UXO contamination is expected to be high in this area.

**Tier 1 Evaluation:** Presently no confirmed contamination; historical accounts report a relatively short period of use by the US military. Considered as a low risk due to present low population density and associated forestry plots surrounding the site.

- **Dak To 2:** Dak To 2, approximately 2 km west of Dak To 1, was built by the US military after Dak To 1 to accommodate larger planes in this area. Local inhabitants are presently using the runway as a manioc storage/drying area. Dak To 2 is located between Hwy 14 and a small river valley. The river valley is now a coffee plantation, which would experience some level of annual pesticide loading. There is evidence of now demolished buildings similar to those observed at the A So site in Aluoi Valley. The soil around the base and runway has a very high clay component and is very densely packed. Tan Canh commune is located directly across the roadway from Dak To 2.

*Tier 1 Evaluation:* Presently no confirmed contamination, however, considered as a suspected risk due to historical reports of major battle activity during the war, herbicide use which was often associated with perimeter defenses of larger airstrips, and close proximity to a population group.

#### 2.4.2.4 Gai Lai Province

Although other areas in Gai Lai province were of primary interest, local military personnel limited our access to only visit Bien Ho Lake (approx. 5 km north of Pleiku center) and Ia Bang Commune (approx. 15 km south of Pleiku center).

- **Bien Ho Lake:** Bien Ho Lake is spring fed and supplies 90% of the water to Pleiku town. The lake is rimmed with agriculture and forestry crops. A small collection of rice paddies presently exists at the south end; however, local authorities are seeking to eliminate the rice crop in the reservoir due to the associated pesticide use. There is a fairly low probability of contamination as Bien Ho Lake is outflow only, and 3 km from Pleiku Airport.

*Tier 1 Evaluation:* Presently no confirmed contamination and considered low risk due to steep topography, spring (not surface water) fed and low population density.

- **Ia Bang Commune:** Ia Bang commune is about 25 km south of Pleiku close to Hensel Airfield and Dragon Mountain communications site; both sites are presently used by the Vietnamese military. This area may have been subject to aerial spray activities but there is no evidence of herbicide storage or loading at Ia Bang Commune.

*Tier 1 Evaluation:* Presently no confirmed contamination and considered low risk due to no reported herbicide activity at this site during the war.

#### 2.4.2.5 Binh Dinh Province

The field team visited the area around Phu Cat Airfield and an ammunition storage facility (CK52) near Qui Nhon in Binh Dinh Province. Long My Depot was not visited as it no longer exists and is now used as a community forest.

- **Around Phu Cat Airfield:** Phu Cat Airfield was a Ranch Hand site during the war. There was confirmed herbicide storage, loading and plane washing at Phu Cat. Run-off from the herbicide wash area was directed into a small lake used by local inhabitants for raising fish and waterfowl. Due to the perceived dioxin contamination, a ban on food consumption from the lake was implemented in 2002. In an attempt to remediate the contaminated runoff from the airstrip, the Vietnamese military built a concrete remediation structure downstream of the main base run-off area. No information on the success of the structure was available at the time of the first field visit. Population density around the lake and airfield is moderate. Vietnamese military personnel indicated that the area has already been cleared of UXO.

***Tier 1 Evaluation:*** Likely high risk due to anecdotal evidence of dioxin contamination, present Vietnamese military soil remediation structure (for chemical contamination), status as major Operation Ranch Hand site during the war, local population present immediately downstream of suspected contamination, and plans for future development. **(Selected for Phase II assessment.)**

- **CK52 ammunition storage area:** CK52 is located within a military compound and is part of a larger area that is owned by the military. This is a confirmed CS and ammunition storage area, but there is no evidence of herbicide storage. The area is presently being cleared of UXO/CS. Once cleared, the site will be turned over to the local government for future forestry activities. Population density is very low in and around CK52.

***Tier 1 Evaluation:*** Presently no confirmed contamination and considered low risk due to no evidence of herbicide activity, low population density, plans for low density land use, and no contaminant pathway evident from the field survey.

#### **2.4.2.6 Phu Yen Province**

Visited the area around Tuy Hoa south airfield in Phu Yen Province. Tuy Hoa north no longer exists and is now an industrial area in the middle of town.

- **Around Tuy Hoa south airfield:** Tuy Hoa has only been recently brought back into military operation. Soil around the base has a very high sand content. The local climate is dry with no evidence of nearby waterways or standing water areas near the base. Local residents have been feeding cattle on, and living very close to, the base area since the end of the war. Tuy Hoa has not been confirmed as a Ranch Hand site, but US military documentation confirms the presence of herbicides at Tuy Hoa (no amount given). Vietnamese military personnel showed us a raised concrete area that was apparently used for plane washing and maintenance. The presence of substantial tie downs on either side of the concrete area suggests this area was used for long-term plane storage.

***Tier 1 Evaluation:*** Presently no confirmed contamination, however, considered as a suspected risk due to confirmed herbicide use for perimeter defenses, and possible spray-plane wash-down site.

#### **2.4.2.7 Khanh Hoa Province**

Visited areas around Cam Ranh airfield, Dong Ba Thin airfield and Nha Trang airport. Although there was no confirmed Ranch Hand base site in Khanh Hoa Province, Cam Ranh and Nha Trang were major facilities during the war and may have been subjected to extensive perimeter spray activity. All three sites were visited, however access was limited to areas outside of airfield perimeters. The areas around all three sites visited in Khanh Hoa Province exhibit steep sloped terrain and very sandy soils that greatly decrease the opportunity for contaminant sinks to form as a result of herbicide use.

- **Area around Cam Ranh Airfield:** The main airport in the area, Cam Ranh Airfield, is now a combination military and commercial cargo airport. The Vietnamese intend to make it a full commercial airfield in the near future. Although Cam Ranh airfield was a major cargo and storage facility during the American War, it was not an Operation Ranch Hand site; there has been no confirmation of herbicide storage or loading at this facility.

***Tier 1 Evaluation:*** Presently no confirmed contamination, however considered suspected risk due to herbicide use which was often associated with perimeter defenses of major airbases, and possible plans for increased population density.

- **Dong Ba Thin Airfield:** Dong Ba Thin is a small abandoned airfield on the western side of Cam Ranh Bay opposite Cam Ranh airfield. This airfield now has limited use, and serves as a Vietnamese Airforce training facility.

***Tier 1 Evaluation:*** Presently no confirmed contamination and considered low risk due to no evidence of herbicide activity, low population density, and no contaminant pathway evident from the field survey.

- **Nha Trang Airport:** Similar to Cam Ranh Airfield, Nha Trang Airport serves a dual purpose. The military uses half of the airport, while the other half services the growing tourism industry of Nha Trang. There was no reported use or storage of herbicides at Nha Trang Airfield, but some areas may require contamination assessment as development for local tourism industry proceeds.

***Tier 1 Evaluation:*** Presently no confirmed contamination, however, considered as a suspected risk due herbicide use which was often associated with perimeter defenses of major airbases, and plans for increased tourism in the area. **(Selected for Phase II assessment.)**

#### 2.4.2.8 Dong Nai Province

- **Area around Bien Hoa Airfield:** Bien Hoa Airfield was the main Ranch Hand and Agent Orange Spraying location in south VN. Bien Hoa is approximately 1.5 hours drive northeast of HCMC. Previous residual herbicide studies in the Bien Hoa area suggest very high dioxin contamination (Schechter *et al.* 2001, 2002). Run-off from the airfield was suspected to have contaminated the communes downstream of the base. This fact, combined with the relatively high population density, result in the Bien Hoa area being placed very high on the priority list for human health risk due to dioxin contamination.

*Tier 1 Evaluation:* Highest risk group due to confirmed high dioxin contamination, and direct pathway to dense population areas. **(Selected for Phase II assessment.)**

- **Long Binh Depot:** Long Binh Depot is located approximately 10 km south of Bien Hoa Airfield. Long Binh Depot was a major US ammunition storage area and administrative headquarters during the American War. There is no evidence of herbicide storage at Long Binh. Most of the Long Binh area is now heavily industrialized with low population density. A portion of the old Long Binh Depot is used by the Vietnamese military as a communication post.

*Tier 1 Evaluation:* Presently no confirmed contamination and considered low risk due to no evidence of herbicide activity, low population density, and high post-war industrialization.

#### 2.4.2.9 Can Tho City

- **Areas around Can Tho Airfield:** Can Tho, situated in the middle of the Mekong Delta, was the primary Ranch Hand and herbicide spraying program location in the IV Corps (Mekong Delta) zone. Can Tho was the largest ammunition storage area in south VN, and the centre of all US and AVRN IV Corps operations. Agent Orange use was suspected to be heavy, as Can Tho was used as a staging area for defoliation of Ca Mau and other southern coastal areas. Population density is high in surrounding communes (Tra Noc, Tho An Dong, Long Hoa, Binh Thuy, and Gai Xuan). Seasonal flooding, daily tidal inundation and the import of large amounts of fill for development since the end of the war may have resulted in a reduction of herbicide related dioxin contamination.

*Tier 1 Evaluation:* Likely high risk due to anecdotal evidence of dioxin contamination, present Vietnamese military soil remediation structure (for chemical contamination), major Operation Ranch Hand site during the war, and local population immediately downstream of suspected contamination. **(Selected for Phase II assessment.)**

#### 2.4.2.10 Bien Phuoc Province

There are several bases and airfields in this area. As part of the Iron Triangle, the area was bombed and heavily sprayed. Most of the region is now rubber and cashew plantations. There is very little secondary forest left in the region. The area has been resettled recently (post-war). This area was a North Viet Nam stronghold during the war and subjected to frequent and intense bombing sorties. UXO is a major issue in this area and numerous CS caches have been uncovered by the Vietnamese military since the end of the war. The Vietnamese government requires that prior to development, every project in this area must have UXO clearance.

- **Areas around Phuoc Binh Airfield (formerly Ba Ra Airfield):** The area is now almost entirely cashew plantations; the airfield is used for drying cashews. Although the land at Ba Ra is still controlled by the military, local people are allowed to use it for the cashew industry. There is one small stream to the south of the base (not observed). The area appears to exhibit a dry, almost arid climate. This airfield was not a Ranch Hand Operation base, but did receive heavy aerial herbicide applications likely staged from Bien Hoa. The sites examined were approximately 50-75 km north of the area where Hatfield and 10-80 sampled in 1997 (Ma Da forest) and found relatively low residual herbicide dioxin levels (from 2.4 to 20 pg/g TEQ) (Hatfield Consultants Ltd. and 10-80 Committee 1998). Population density is low in the area around Ba Ra.

***Tier 1 Evaluation:*** Presently no confirmed contamination. Considered low risk due to very low population density and surrounding low-density land-use activities (e.g., forestry, plantations).

#### 2.4.2.11 Pleiku Airport

Although some areas in the vicinity of Pleiku town were visited during the field reconnaissance survey (Bien Ho Lake and Ia Bang Commune), the local military denied the field crew access to sites in and around airports or former US military sites, including Pleiku Airport.

- **Pleiku Airfield:** Pleiku airfield was a Ranch Hand site. Anecdotal information provided by a US veteran suggested that during the war, up to eight C-123 herbicide plane flights went in and out of Pleiku Airfield per day. Pleiku Airfield is now the community airport and is not presently used by the Vietnamese military. The population density around Pleiku Airport is relatively low. Directly adjacent to the southeast border of the airport is a low-lying valley with rice paddies, vegetable crops and coffee plants. More investigation into possible contaminant levels and human pathways (i.e., nearby drainage patterns and socio-economic activities) is required.

***Tier 1 Evaluation:*** Presently no confirmed contamination, however, considered as a suspected risk due to confirmed Ranch Hand herbicide activities during the war, and possible downstream pathway to humans identified. **(Selected for Phase II assessment.)**

#### **2.4.2.12 Tan Son Nhut Airport**

Tan Son Nhut Airport was not included in the field reconnaissance survey portion of the Tier 1 Assessment. However, data acquired subsequent to the March 2004 field survey activities indicated that Tan Son Nhut should be included as an area of interest.

- **Tan Son Nhut Airport:** Tan Son Nhut Airport in Ho Chi Minh City was the first staging site for Operation Ranch Hand in Vietnam. After one or two years of initial activity, the Operation Ranch Hand base in the HCMC area was moved to Bien Hoa. Since that time, the degree of development in the area around Ho Chi Minh City and Tan Son Nhut has changed significantly. Although, the airport was utilized as an Operation Ranch Hand base for a short period, further investigation is warranted due to the use of herbicides with high dioxin content (i.e., Agent Purple, which had significantly higher concentration of dioxin, relative to Agent Orange) during initial Ranch Hand activities.

***Tier 1 Evaluation:*** Presently no confirmed contamination, however, considered as a suspected risk due to early Ranch Hand activities. This site did not receive a higher rating due to extensive industrialization since the end of the war. **(Selected for Phase II assessment.)**

#### **2.4.2.13 Phan Rang Airbase**

Phan Rang is located approximately 100 km due south of Cam Ranh Airbase and Port facility in Ninh Thuan Province. The provincial military, due to present activities in the area, denied the field crew access to Phan Rang Airbase.

- **Phan Rang Airbase:** US military reports state that, for a short period after Bien Hoa, Phan Rang Airbase became the primary Ranch Hand site for all herbicide activities in southern Viet Nam. Anecdotal reports indicate that population density in the Phan Rang Area is relatively low and the main economic activity is agriculture.

***Tier 1 Evaluation:*** Presently no confirmed contamination, however, considered as a suspected risk due to late Ranch Hand activities during the war.



## 2.5 PHASE II: TIER 2 ASSESSMENT

### 2.5.1 Perspective

Phase II of the Hot Spot Project was designed to assess the level of dioxin contamination in soils/sediment (source) and to render a preliminary assessment of the potential health risk (pathway) to exposed human populations (receiver) in each of the priority areas.

Subsequent to completion of Phase I/Tier 1 activities the priority areas were selected for further field sampling investigations (Table 2.6, Figure 2.3).

**Table 2.6 Priority areas investigated during the Phase II dioxin sampling program, March/April 2005.**

Former US Airbase	Administrative Unit	Priority Ranking from Phase I*	Dates Sampled	Total Number of Samples Collected
Da Nang	Da Nang City	1	March 13 – March 17	27
Pleiku	Gai Lai Province	2	March 18 – March 20	14
Phu Cat	Binh Dinh Province	1	March 22 – March 25	19
Nha Trang	Khanh Hoa Province	not ranked**	March 27	5
Bien Hoa	Dong Nai Province	1	March 29 – April 1	36
Can Tho	Can Tho City	2	April 3 – April 4	22
Tan Son Nhut	Ho Chi Minh City	2	April 5 – April 7	4
<b>Total:</b>				<b>127***</b>

\* Rank 1 sites are high probability of contamination and high probability of human contact. Rank 2 sites are any combination of high and medium levels of contamination and probability of contact.

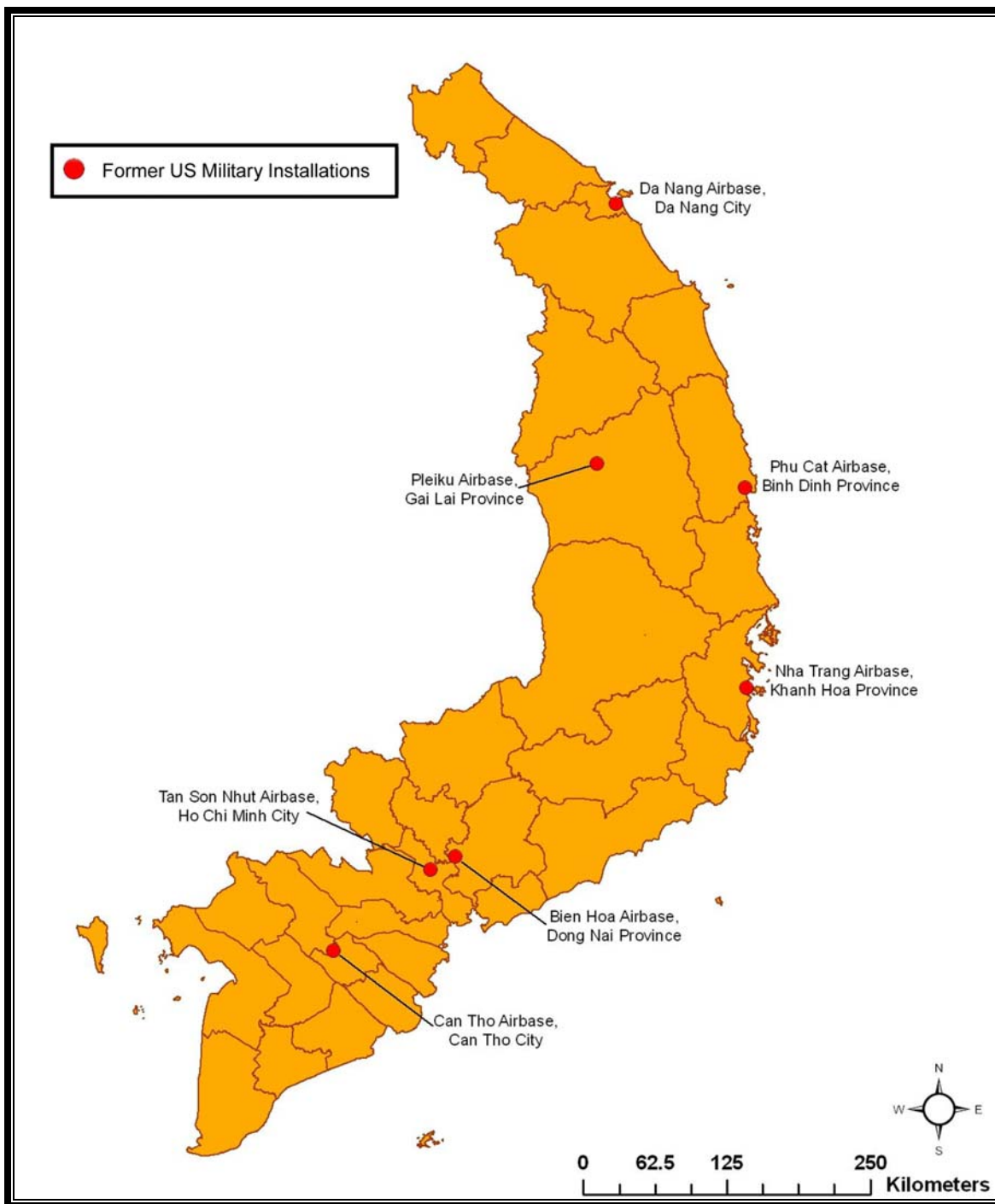
\*\* Added due to subsequent information obtained since the completion of Phase I.

\*\*\* Out of these, 93 would be selected for analyses.

### 2.5.2 Additional Data Collection at US Archives, Washington, D.C.

Prior to the Phase II field sampling program, a further data collection effort at the United States Archives (US Archives) in Washington D.C. was undertaken from February 13 to 16, 2005. Additional historical photographs, spray mission reports, maps, and base layouts were obtained during this visit. Airbase plan drawings and engineering sketches were of particular interest, as they provided detailed information on airbase utility, drainage, and storm water design at a small scale.

**Figure 2.3** Former US military installations sampled during the Phase II field program, March/April 2005.



### 2.5.3 Sample Site Selection

The level of sampling effort at each priority area depended upon the degree of expected contamination (Phase I/Tier 1 assessment), environmental conditions at the time of sampling, availability of local personnel to aid in guiding sampling efforts, and site access. At each of the priority areas, a one-day scoping exercise was undertaken to meet the appropriate local authorities, review environmental conditions, and collect land use information for each site. Based on the perceived risk, and the expert opinion of local authorities and the field team, a number of environmental samples (soil and/or sediment) were collected for chemical analysis. A number of contingency samples were allowed for opportunistic sampling should in-field review of suspected pathways warrant.

### 2.5.4 Dioxin Sampling Protocols

Soil and sediment sampling protocols were developed during previous dioxin/furan monitoring programs conducted by Hatfield and 10-80 Division in Viet Nam and for the pulp and paper industry in British Columbia (Dwernychuk *et al.*, 2002). Field supplies transported from Canada included stainless steel sampling equipment (core samplers and pans), pre-cleaned glass jars with Teflon lined lids, a Garmin hand-held global positioning system (GPS) unit, pre-numbered labels, and data sheets. Acetone and hexane were obtained in Ha Noi prior to the start of the sampling program to be used for cleaning of all sampling equipment.

Important components of the study included ensuring standard Quality Assurance/Quality Control (QA/QC) procedures were followed during all sample collection activities. Some important QA/QC considerations are described below:

- Disposable latex gloves were used to handle all samples and specimens, and were changed between samples;
- Stainless steel dissection trays and tools (e.g., core sampler, trowel, and spoons) were rinsed in ambient water, then acetone and hexane, before each use and between sample collections;
- Sample jars were pre-cleaned by our Canadian dioxin analytical laboratory, AXYS Analytical, prior to shipment to Viet Nam;
- Duplicate samples were collected at all sampling stations;
- All samples were placed in heat-treated, wide-mouth glass jars, appropriately labeled, and stored in a cooler after sample collection;
- The location of each sampling station was recorded using a hand-held GPS, as well as photographed to ensure repeatability in future sampling programs;
- Detailed data sheets were filled out for each sample taken. Information collected on the data sheet included date and time samples, local

conditions, past present and future land use, proximity to human populations, and possible contaminant pathways to those populations. (an example of the field data sheet is provided in Appendix A2);

- A GPS reading was taken at each site;
- Notations were made of the sampling equipment used;
- Sketch maps of each sampling site were made when the sampling team was on site; and
- Smoking was not permitted in the vicinity of sampling activities.

Sampling boundaries were set during pre-sampling reconnaissance. The guiding principle for the selection of sampling location was the potential for contamination (i.e., in, near, or down slope of predicted storage and/or sprayed areas) and the presence of a potential contaminant pathway, which may lead to human contact. Once these boundaries were delineated in the field, the sampling crew determined the type and location of sample collections.

For safety, and prior to sampling, all surface sampling sites were swept for the presence of landmines and unexploded ordnance (UXO) by a demining expert provided to the program by the Viet Nam Ministry of Defense.

#### **2.5.4.1 Soil Sampling**

Composite soil samples were collected from a variety of soil types, including fields under cultivation (e.g., vegetables and rice), fallow fields, naturally vegetated areas, and household gardens.

Soil samples were collected using either a stainless steel core sampler or a stainless steel trowel. The trowel was used at sites where the soil was too hard for the corer to effectively penetrate the ground surface. Each soil sample was taken at the 0-10 cm depth and consisted of a composite of ten individual “grabs” collected within approximately a 30 m by 30 m area. Each individual sample was placed in the pan and stirred into a homogenous mixture to constitute one composite sample. The composite sample was then transferred into two separate glass jars for subsequent storage.

#### **2.5.4.2 Sediment Sampling**

Sediments were collected from ditches, lakes, rivers, and ponds situated at or downstream of the perceived contamination area. The depth below water surface for each sample was determined by site conditions. In some cases samples were taken from the water’s edge, while other samples were taken from the middle of the water body. Generally, an attempt was made to collect samples from the depositional zone in each ditch, lake, river, or pond sampled. Sediments were either scooped directly into the sample jar or transferred from the sampling tool into the jar. In deeper areas, a stainless steel Eckman dredge

was used to collect the sample. Two individual samples were collected at each site and immediately transferred to the storage facility. Composite sediment samples were not collected to avoid extensive disturbance of bottom sediments.

## **2.5.5 Samples Collected**

The following section describes additional information on each sample area that was obtained during the February 2005 US Archives data search and/or information collected during the Phase II sampling program.

### **2.5.5.1 Da Nang (Appendix A3.1)**

#### ***Rationale for Selection***

Da Nang airbase (Da Nang City) was selected as a Priority 1 location after a detailed review of the available historic literature, which documents the numerous Ranch Hand sorties flown from the Da Nang airbase. The literature search identified an intermediary Agent Orange storage depot at the ARVN-controlled An Don storage facility located 5 km east of Da Nang airbase across the Han River.

In the spring of 2002, at the request of the Vietnamese Military Chemical Corps, Hatfield participated in a field reconnaissance exercise at Da Nang airbase. During this visit, the locations of the loading and wash down areas used for herbicide spray missions, as well as the airbase drainage patterns, were found to be concentrated at the northeast corner of the airbase. An engineering drawing of Da Nang airbase infrastructure and drainage patterns obtained during the US Archives data search in February 2005 further confirmed these observations.

#### ***Samples Collected***

The sampling efforts around the Da Nang airbase concentrated on the drainage network and wetland areas receiving waters from the former herbicide storage and wash-down area within the base. Additional sampling targeted a wider geographic area, and included sample collection from outfalls observed to intersect or originate from the Da Nang airfield and the An Don storage facility.

This approach was utilized to identify the extent of the suspected contamination at the northeast corner of the airbase, as well as to quantify any contaminated areas that would be associated with perimeter spraying or spills that may have occurred during the transport or storage of herbicides prior to deployment.

A total of 24 sediment and 3 soil samples were collected in Da Nang between March 14 and March 17, 2005. Of the 27 total samples collected, eighteen (18) were samples that were used to identify the extent of potential contamination from the known herbicide loading and wash-down facility on the northeast corner of the Da Nang airbase; the remaining nine (9) samples (05VN003 to 009, 019, and 020) were used to identify additional potential contaminated sites in the general vicinity of the Da Nang study area. Sample site information and locations are provided in Table 2.7 and Figure 2.4. Those samples submitted for dioxin analyses are also highlighted in Figure 2.4.

**Table 2.7 Samples collected at Da Nang airbase, March 2005.**

<b>Sample No.<sup>1</sup></b>	<b>Sample Date</b>	<b>Sample Type</b>	<b>Sample Method</b>	<b>Sample Coordinates (UTM)</b>	<b>Sample Description</b>
<b>05VN-001</b>	March 14	Sediment (grab)	Hand	199072.1776558	Fines, manmade channel through rice paddy
05VN-002	March 14	Sediment (grab)	Hand	199042.1776601	Fines, below culvert ~ 60m downstream from 05VN001
<b>05VN-003</b>	March 14	Sediment (grab)	Hand	198450.1777932	Fines, downstream of 05VN002
05VN-004	March 15	Sediment (grab)	Eckman	198414.1778631	Fines, Phu Loc River upstream from northeast base outfall
05VN-005	March 15	Sediment (grab)	Eckman	198542.1778791	Sand, Phu Loc River downstream from northeast base outfall
05VN-006	March 15	Sediment (grab)	Eckman	198547.1778716	Fines, Phu Loc River downstream from northeast base outfall
<b>05VN-007</b>	March 15	Sediment (grab)	Eckman	198547.1778716	Fines, Phu Loc River downstream from northeast base outfall
<b>05VN-008</b>	March 15	Sediment (grab)	Eckman	198520.1778672	Sand ~ 10m upstream from northeast base outfall
<b>05VN-009</b>	March 15	Sediment (grab)	Eckman	198553.1778698	Dark Fines, Phu Loc River
<b>05VN-010</b>	March 15	Sediment (grab)	Eckman	201052.1777620	Fines, southwest end of Lake 29.3
<b>05VN-011</b>	March 15	Sediment (grab)	Eckman	200973.1777789	Fines, west side of Lake 29.3
<b>05VN-012</b>	March 15	Sediment (grab)	Eckman	200846.1778088	Fines, northwest end of Lake 29.3
<b>05VN-013</b>	March 15	Sediment (grab)	Eckman	201490.1778056	Fines, west section of Thac Gian Lake
05VN-014	March 15	Sediment (grab)	Eckman	201563.1778051	Fines, east section of Thac Gian Lake
<b>05VN-015</b>	March 15	Sediment (grab)	Hand	Approx. 50m west of 05VN016	Soft, west side of Wetland 2
<b>05VN-016</b>	March 15	Sediment (grab)	Hand	199651.1777817	Compacted, east side of wetland 2, near base outfall
<b>05VN-017</b>	March 16	Soil (comp of 10)	Trowel	199800.1778592	Loam, small vegetable garden
<b>05VN-018</b>	March 16	Soil (comp of 10)	Trowel	199957.1778482	Loam, small vegetable garden

<sup>1</sup> Bold denotes those samples submitted for laboratory analyses.

**Table 2.7 (Cont'd.)**

<b>Sample No.</b>	<b>Sample Date</b>	<b>Sample Type</b>	<b>Sample Method</b>	<b>Sample Coordinates (UTM)</b>	<b>Sample Description</b>
05VN-019	March 16	Soil (comp of 10)	Trowel	198335.1778296	Loam, small vegetable garden
05VN-020	March 16	Sediment (grab)	Hand	198125.1778639	Fines, drainage channel 20m u/s from confluence with Phu Loc River
<b>05VN-021</b>	March 16	Sediment (grab)	Eckman	201238.1775809	Fines, unnamed drainage from southeast base area
<b>05VN-022</b>	March 16	Sediment (grab)	Hand	201024.1775874	Fines, 100 m u/s from 05VN021, on same drainage channel
05VN-023	March 16	Sediment (grab)	Eckman	198392.1779015	Sand, Phu Loc River approx. 400 m from confluence with ocean
<b>05VN-026</b>	March 17	Sediment (grab)	Hand	204578.1779158	"American Ditch" sample immediately d/s from An Don perimeter fence
<b>05VN-027</b>	March 17	Soil (comp of 10)	Corer	203993.1780225	Loam, grassy area next to An Don drainage receiving wetland
<b>05VN-028</b>	March 17	Sediment (grab)	Eckman	203979.1780251	Fines, wetland receiving drainage water from An Don
<b>05VN-029</b>	March 17	Sediment (grab)	Corer	201272.1776379	Fines, stormwater drainage channel near airbase perimeter wall

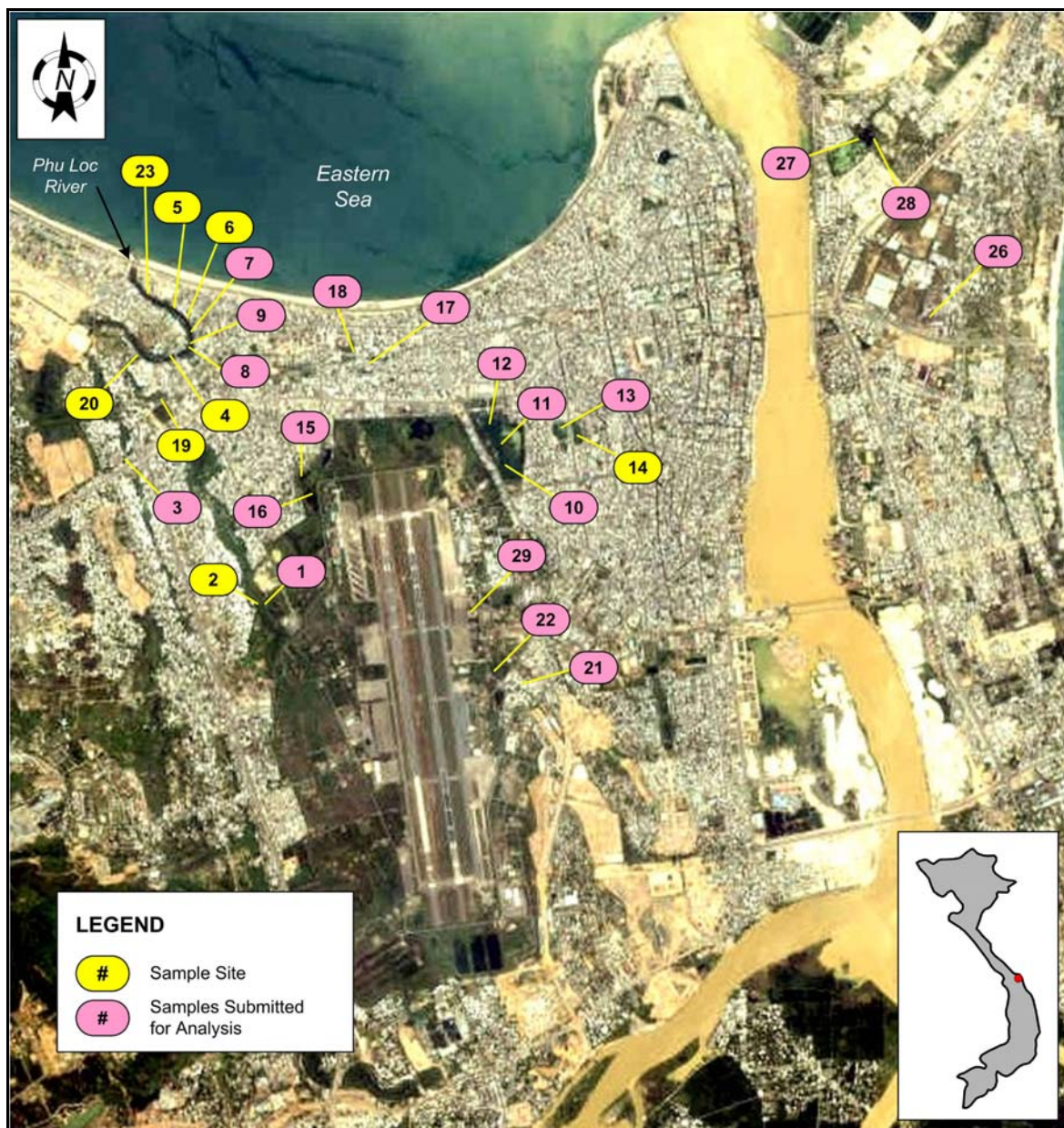
<sup>1</sup> Bold denotes those samples submitted for laboratory analyses.

Note: Sample numbers 05VN-024 and 05VN-025 were discarded.

Site assessments conducted in conjunction with the sampling program found that urban development has reduced (due to asphalt and concrete capping) the potential for human exposure at a number of the sites of concern (i.e., elimination of contaminant/receptor connectivity). Currently, much of the surface water from the Da Nang airfield and the An Don storage facility is captured and transported through the sub-surface storm water system before being discharged to the Phu Loc and Han Rivers. The orientation and pattern of the stormwater system was detailed by representatives from the Provincial Ministry of Public Works during the March 14 field reconnaissance.



**Figure 2.4** Ikonos satellite image (2003) of Da Nang airbase showing sample locations from the March 2005 Phase II field program.





### **2.5.5.2 Pleiku (Appendix A3.2)**

#### ***Rationale for Selection***

Pleiku airbase (Gai Lai Province) was selected as a Priority 2 site primarily as a result of its use as a staging area for Ranch Hand missions. Additionally, the airbase is located on top of a plateau created by the fluvial erosion of two tributaries that border the airbase, and converge at the east end of the plateau. This topography likely resulted in extensive perimeter spraying of herbicides to maintain sightlines and discourage infiltrations. The study team did not have clear anecdotal information regarding where herbicides were stored/loaded.

#### ***Samples Collected***

Samples were collected from the perimeter of the airbase, on or at the bottom of the plateau edge. Specific samples were taken from the base of the plateau, the valley floor, and the east to west flowing tributary draining the south side of the airbase. The stream that borders the north side of the base is contained in irrigation channels for agricultural purposes; sampling in this area was confined to the irrigation channels and rice paddies. The locations and type of samples collected around the Pleiku airbase are provided in Table 2.8.

A total of 14 samples were collected from around the Pleiku airbase (Table 2.8 and Figure 2.5). Topography of the area and engineering base drawings obtained from the US Archives in Washington D.C. indicate that surface water was routed away from the airstrip to the north and south sides of the airbase, and drained to the valley floor via a number of concrete channels.

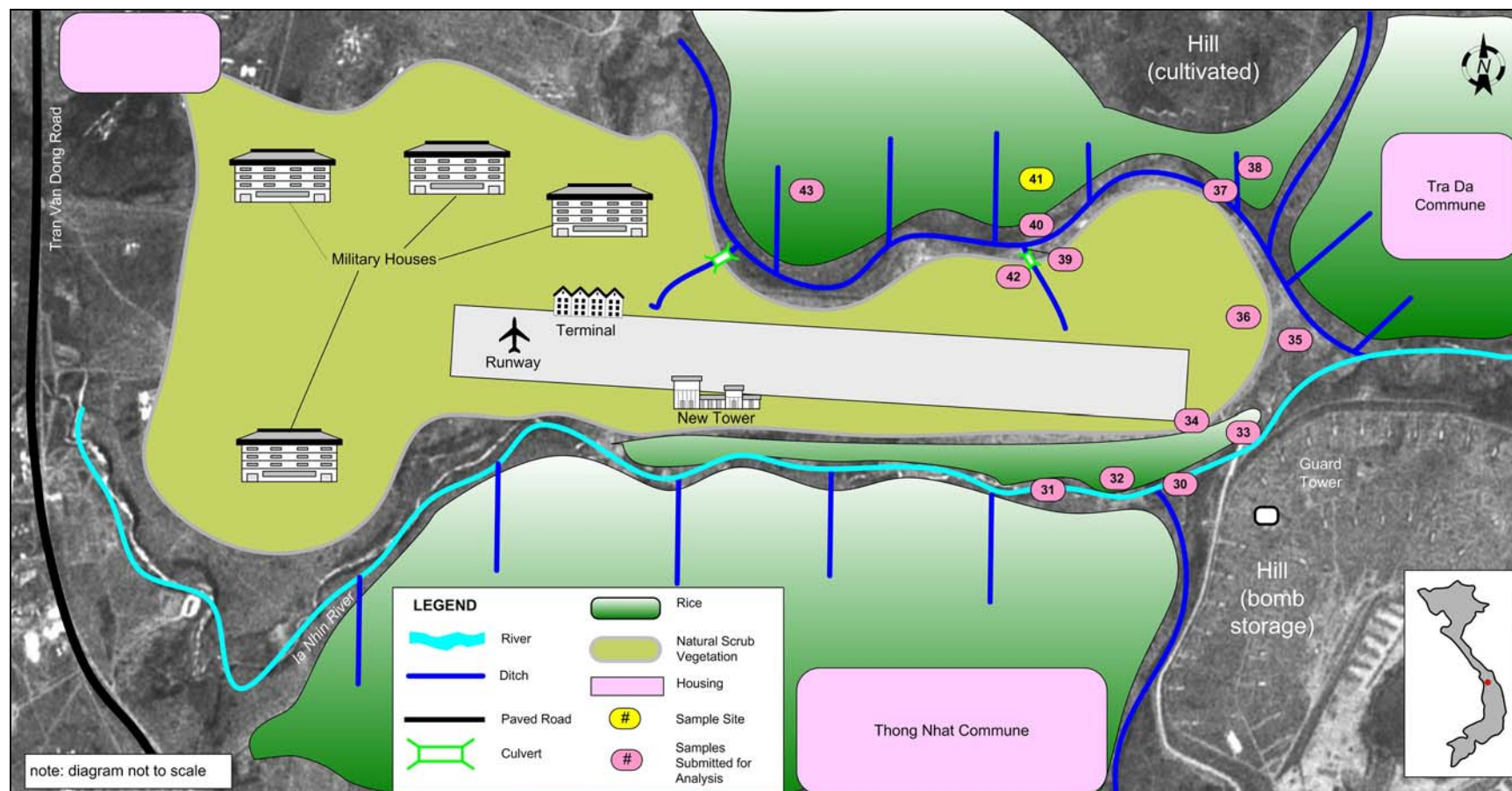
The Pleiku study area consisted primarily of rice paddies and grazing fields for cattle. A number of small houses were observed along the valley walls opposite the airbase, and a larger commune (Thong Nhat Commune) was situated approximately 1 km to the northeast of the airbase perimeter.

**Table 2.8 Samples collected at Pleiku airbase, March 2005.**

<b>Sample No.<sup>1</sup></b>	<b>Sample Date</b>	<b>Sample Type</b>	<b>Sample Method</b>	<b>Sample Coordinates (UTM)</b>	<b>Sample Description</b>
<b>05VN-030</b>	March 19	Sediment (grab)	Hand	178890.1549999	Fines, stream at east end of base
<b>05VN-031</b>	March 19	Sediment (grab)	Hand	178835.1549903	Fines, stream at east end of base ~ 100m u/s of 05VN030
<b>05VN-032</b>	March 19	Soil (comp of 10)	Corer	178822.1549918	Fines, rice paddy located between 05VN030 & 031
<b>05VN-033</b>	March 19	Soil (comp of 10)	Corer	179080.1550204	Fines, rice paddy east of end the airstrip
<b>05VN-034</b>	March 19	Soil (comp of 10)	Trowel	179006.1550166	Reddish Brown and Dry, natural grass and shrub area at base of airbase slope
<b>05VN-035</b>	March 20	Soil (comp of 10)	Corer	179118.1550570	Moist clay, fallow rice paddy between north and south stream confluence
<b>05VN-036</b>	March 20	Soil (comp of 10)	Trowel	179014.1550584	Red Brown Clay, located in old excavated area, possibly ammo dump
<b>05VN-037</b>	March 20	Soil (comp of 10)	Trowel	178875.1550713	Red Brown Soil, non-agricultural land off west end of airbase
<b>05VN-038</b>	March 20	Soil (comp of 10)	Corer	178905.1500757	Dark Brown, fallow rice paddy on north side of airbase
<b>05VN-039</b>	March 20	Soil (comp of 10)	Corer	178519.1550727	Dark Brown, fallow rice paddy at toe of north airbase slope
<b>05VN-040</b>	March 20	Sediment (grab)	Hand	178519.1550787	Fines, small drainage channel extending towards runway tarmac
<b>05VN-041</b>	March 20	Soil (comp of 10)	Corer	178532.1500825	Dark Brown, fallow rice paddy ~ 100m from north toe of airbase
<b>05VN-042</b>	March 20	Soil (comp of 10)	Trowel	178504.1550715	
<b>05VN-043</b>	March 20	Soil (comp of 10)	Corer	177820.1550509	Fines, valley floor cross section from partially flooded rice paddy

<sup>1</sup> Bold denotes those samples submitted for laboratory analyses.

**Figure 2.5** 1967 Corona satellite image of Pleiku airbase overlaid with key features and sample locations from the March 2005 Phase II field program.



### 2.5.5.3 Phu Cat (Appendix A3.3)

#### ***Rationale for Selection***

Phu Cat airbase (Binh Dinh Province) was chosen as a Priority 1 site due to extensive historical data on Ranch Hand operations in the area (i.e., it was a major storage and loading area for Agent Orange); reported (Dr. Tran Mahn Hung, *pers. comm.*) mitigation activities by the Vietnamese Military; and field observations confirming a source, pathway, and receptor relationship of the contaminant.

An engineering drawing of Phu Cat airbase infrastructure and drainage patterns was obtained during the US Archives data search in February 2005. While in the field, local authorities provided a map showing the boundaries of surrounding communes, and present land use in the area.

#### ***Samples Collected***

The primary focus of the Phu Cat field sampling program was a reservoir and stream that received drainage downstream of the contamination source, and a mitigation site located within the airbase property. Secondary sampling locations were chosen at various locations around the airstrip that likely received repeated perimeter spray effort by both backpack- and truck-mounted spray operations. Another reservoir at the northeast end of the base was suspected to contain receiving waters and runoff sediments from that end of the base.

A total of 19 samples were collected around the Phu Cat airbase; eight (8) sediments and eleven (11) soils. Sample site information and locations are provided in Table 2.9 and Figure 2.6.

As with many former US airbases, the Phu Cat airbase now serves as a dual military and commercial facility. This airstrip is the main air passenger and freight facility for the nearby city of Qui Nhon (population 240,000), located approximately 30 km southeast of Phu Cat. However, extensive industrialization is occurring along the Highway 1 corridor between Qui Nhon and Phu Cat, which will result in an increase in both freight and passenger utilization of the Phu Cat airport.

Land use in and around the Phu Cat airbase has changed substantially since the end of the American war. The major change is the creation of two irrigation reservoirs: South Lake and North Lake. South Lake retains run-off from the suspected hot spot.

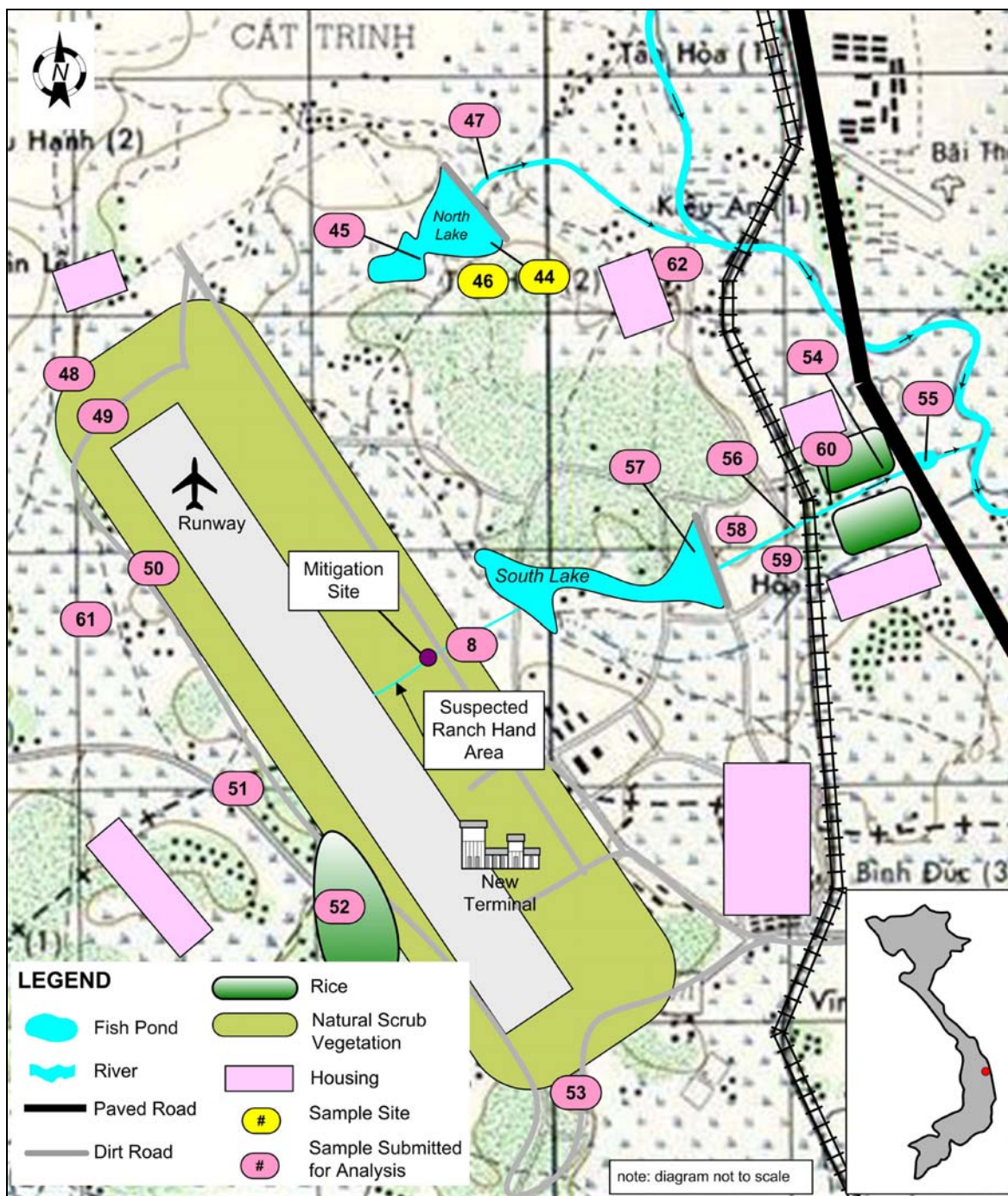
**Table 2.9      Samples collected at Phu Cat airbase, March 2005. Sample number 04VN008 was collected in 2004.**

<b>Sample No. <sup>1</sup></b>	<b>Sample Date</b>	<b>Sample Type</b>	<b>Sample Method</b>	<b>Sample Coordinates (UTM)</b>	<b>Sample Description</b>
<b>04VN-008</b>	Feb 29, 2004	Sediment (grab)	Hand	n/a	d/s of remediation area
05VN-044	March 23	Sediment (grab)	Hand	289262.1545793	Fines, north lake near dyke
<b>05VN-045</b>	March 23	Sediment (grab)	Hand	289014.1545661	Fines, north lake at narrows
05VN-046	March 23	Soil (comp of 10)	Corer	289187.1545665	Loam, north lake on southeast shore
<b>05VN-047</b>	March 23	Sediment (grab)	Hand	289178.1545906	Fines and Sand, outlet of north lake
<b>05VN-048</b>	March 23	Soil (comp of 10)	Corer	287425.1545174	Clay, just off runway apron on northwest corner
<b>05VN-049</b>	March 23	Soil (comp of 10)	Corer	287534.1544923	Clay, just off runway apron on west corner
<b>05VN-050</b>	March 23	Soil (comp of 10)	Corer	287900.1544280	Just off runway apron on west side of base
<b>05VN-051</b>	March 23	Soil (comp of 10)	Corer	288291.1543609	Sand/Fines, southwest corner of airstrip in a grove of Dieu trees
<b>05VN-052</b>	March 23	Soil (comp of 10)	Corer	288534.1542870	Fines, southwest of airstrip in rice fields
<b>05VN-053</b>	March 23	Sediment (grab)	Hand	289884.1541817	Fines, in stream that drains south end of airstrip
<b>05VN-054</b>	March 24	Soil (comp of 10)	Trowel	291114.1544470	Fines/Sand, rice field d/s of south lake and just u/s of Hwy 1
<b>05VN-055</b>	March 24	Sediment (grab)	Hand	291197.1544480	Fines, pond just d/s of Hwy 1
<b>05VN-056</b>	March 24	Sediment (grab)	Hand	290523.1544093	Fines/Sand, d/s of south lake and u/s of rail bridge
<b>05VN-057</b>	March 24	Sediment (grab)	Hand	290182.1544041	Fines, taken near dyke in south lake
<b>05VN-058</b>	March 24	Soil (comp of 10)	Trowel	290466.1544132	Clay and fines, taken on side slope d/s of south lake
<b>05VN-059</b>	March 24	Soil (comp of 10)	Trowel	290562.15441155	Fines and Sand, taken in flood plain d/s of south lake
<b>05VN-060</b>	March 24	Soil (comp of 10)	Trowel	290652.1544187	Fines and Sand, taken in flood plain d/s of rail bridge
<b>05VN-061</b>	March 27	Soil (comp of 10)	Trowel	287670.1544196	Red Clay, taken in fallow rice field 800 m west of airstrip
<b>05VN-062</b>	March 27	Sediment (grab)	Hand	290196.1545568	Fines and Sand, taken in spring northeast of airstrip

<sup>1</sup> Bold denotes those samples submitted for laboratory analyses.



**Figure 2.6 US military map of Phu Cat airbase showing key features and sample locations from the March 2005 Phase II field program.**



#### 2.5.5.4 Nha Trang (Appendix A3.4)

##### ***Rationale for Selection***

The inclusion of Nha Trang airbase (after it was excluded from the Phase I priority ranking) was due to additional information gained from the US Archives search in February 2005. In particular, a photograph (Plate 2.1) showing the Nha Trang Operation Ranch Hand site confirmed Ranch Hand operations at this base. The photograph below was compared with photographs taken by the research team. By using the runway, road, and mountains in the background, the team was able to determine the general location of the Ranch Hand loading site for sampling. An engineering plan of the base was also obtained during this visit.

Using the photo, the specific location of the Ranch hand sign and C-123 spray planes was determined; field crews were able to sample soil at this location and sediments in a drainage ditch downstream of this area on the base.

Half of the former airbase (northeast side) is now utilized as the main commercial passenger airport for Nha Trang. The southwest area contains the former Ranch Hand area and is presently used by the Vietnamese military.

**Plate 2.1**      **Photograph of Operation Ranch Hand site at Nha Trang Airbase, date unknown.**



*Source: US Archives, Washington DC.*

### **Samples Collected**

At the Nha Trang site, four (4) soil samples were collected on the airbase property at or near the former Operation Ranch Hand site. One sediment sample was collected at the outlet of a storm sewer system that drains the portion of the airbase that contained the former Ranch Hand area (Table 2.10 and Figure 2.7).

A comparison of wartime aerial imagery with recent satellite data of the airbase area shows how urbanization has changed land use surrounding the airbase. In particular, the section of storm sewer from the edge of the base leading out to the ocean has been reconfigured as a result of urban/housing development since the end of the war (Figure 2.8).

The field assessment found that current human contact with soils on the base is limited to military personnel performing maintenance on the land around the existing tarmac. The storm sewer system flows through a densely populated housing/retail area and through outlets in a seaside park which were observed to be frequented by school groups and recreating youths. The outlet does not appear to connect with the ocean at normal flows. At the time of the field survey, the storm water came within approximately 20 m of the ocean edge, then appears to drain subsurface. It is unclear whether or not there is a direct connection to the ocean during the wet season.

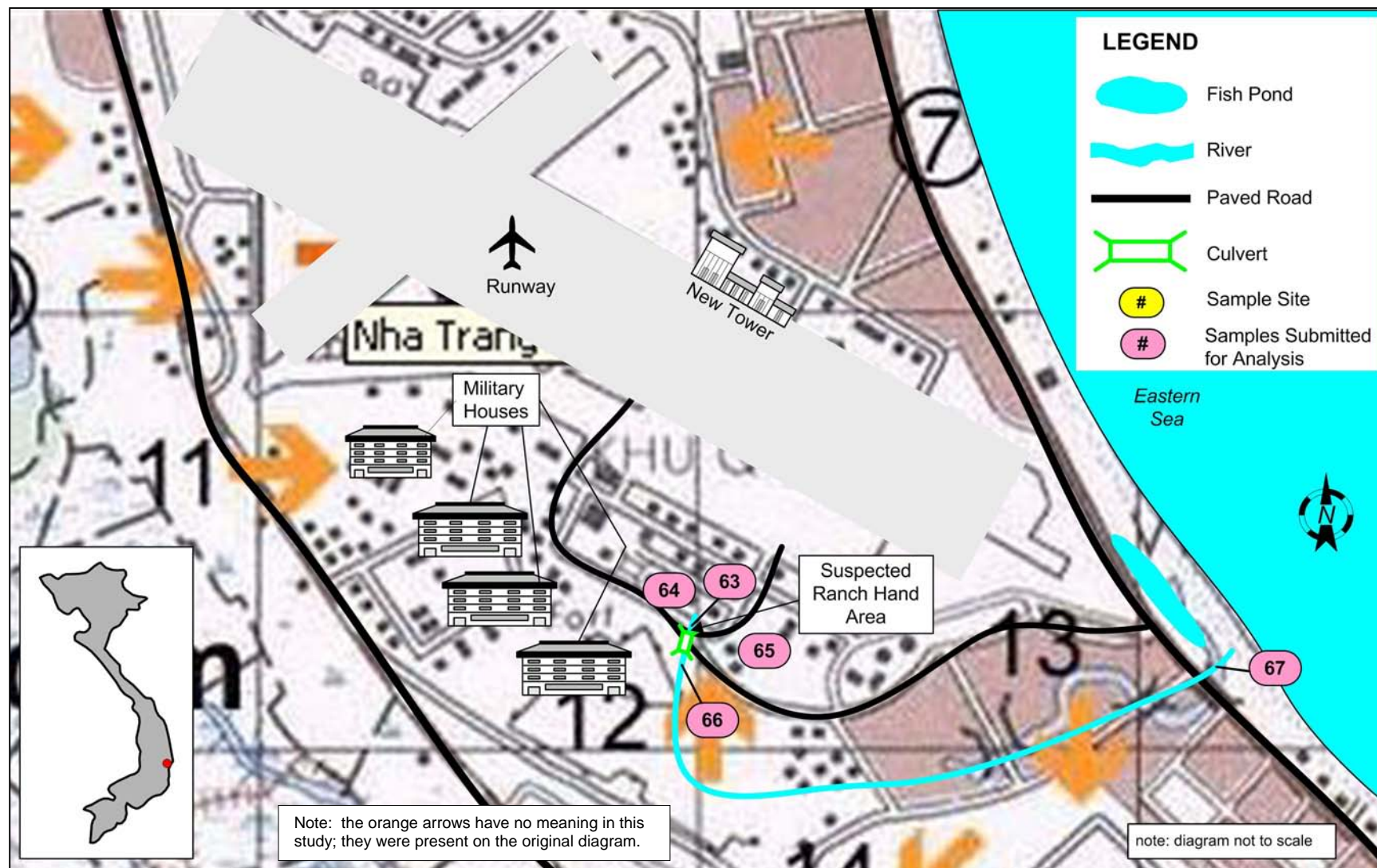
**Table 2.10 Samples collected at Nha Trang airbase, March 2005.**

<b>Sample No.<sup>1</sup></b>	<b>Sample Date</b>	<b>Sample Type</b>	<b>Sample Method</b>	<b>Sample Coordinates</b>	<b>Sample Description</b>
<b>05VN-063</b>	March 27	Soil (comp of 10)	Trowel	303919.1351622	High sand content, Yellow/Gray
<b>05VN-064</b>	March 27	Soil (comp of 10)	Trowel	303879.1351622	High sand content, Yellow/Gray
<b>05VN-065</b>	March 27	Soil (comp of 10)	Trowel	303863.1351622	High sand content, Yellow/Gray
<b>05VN-066</b>	March 27	Soil (comp of 10)	Trowel	303919.1351606	Fines, Black
<b>05VN-067</b>	March 27	Sediment (grab)	Hand	304746.1351467	High sand content, Black

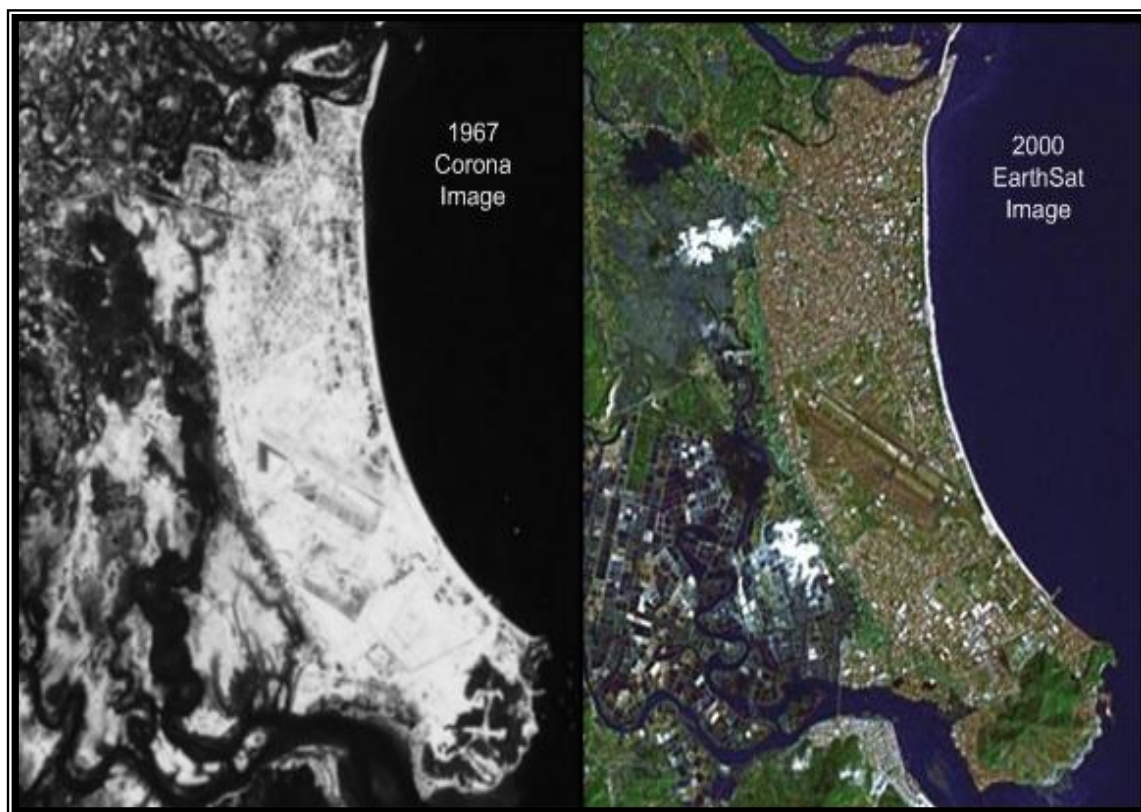
<sup>1</sup> Bold denotes those samples submitted for laboratory analyses.



**Figure 2.7** US military map of Nha Trang airbase showing key features and sample locations from the March 2005 Phase II field program.



**Figure 2.8 Comparison of Nha Trang airbase images from 1967 (Corona Satellite) and 2000 (EarthSat Satellite).**



#### **2.5.5.5 Bien Hoa (Appendix A3.5)**

##### ***Rationale for Selection***

Bien Hoa airfield (Dong Nai Province) was the primary base for Ranch Hand activities in southern Viet Nam. Previous residual herbicide studies in the Bien Hoa area suggest very high dioxin contamination (Schecter *et al.* 2001, 2002). Run-off from the airfield was suspected to have contaminated the communes downstream of the base. This fact, combined with the relatively high population density, results in the Bien Hoa area being placed very high on the priority list for human health risk due to dioxin contamination.

The research team paid particular attention to sampling in areas downstream of the perceived hot spot, but also took samples in other areas for comparison purposes.

##### ***Samples Collected***

In the Bien Hoa area, sixteen (16) soil samples and twenty (20) sediment samples were collected. As access to the base property was restricted to all sampling personnel, samples were taken from areas around the base including sites that receive direct drainage from the base, areas of high human/environmental contact, and areas that were subject to repeated hand/truck spray around the base perimeter (Table 2.11 and Figures 2.9 and 2.10).

**Table 2.11 Samples collected at Bien Hoa airbase, March 2005. Sample numbers 04VN-011, 04VN-013, and 04VN-014 were collected in 2004.**

<b>Sample No.<sup>1</sup></b>	<b>Sample Date</b>	<b>Sample Type</b>	<b>Sample Method</b>	<b>Sample Coordinates</b>	<b>Sample Description</b>
<b>04VN-011</b>	Mar 10, 2004	Sediment (grab)	Hand	697030.1212687	Marsh close SW base
<b>04VN-013</b>	Mar 10, 2004	Soil (grab)	Hand	696829.1213740	Farmers field west of base
<b>04VN-014</b>	Mar 10, 2004	Sediment (grab)	Hand	698858.1211444	Bien Hung Lake
05VN-068	March 30	Soil (comp of 10)	Trowel	696865.1214281	Light Brown, Loam
05VN-069	March 30	Soil (comp of 10)	Corer	697044.1214390	Light Brown, Loam
05VN-070	March 30	Soil (comp of 10)	Trowel	697015.1214995	Reddish Brown
05VN-071	March 30	Sediment (grab)	Hand	896875.1214181	60% Sand
05VN-072	March 30	Sediment (grab)	Hand	696785.1214015	Fines
<b>05VN-073</b>	March 30	Soil (comp of 10)	Corer	696791.1214022	Loam
<b>05VN-074</b>	March 30	Soil (comp of 10)	Corer	698302.1211815	Loam
05VN-075	March 30	Sediment (grab)	Hand	697985.1211579	Grey Clay
05VN-076	March 30	Sediment (grab)	Hand	697970.1211582	Black, Fines
<b>05VN-077</b>	March 30	Soil (comp of 10)	Corer	698275.1211651	Grey, Brown
<b>05VN-078</b>	March 30	Sediment (grab)	Hand	699165.1212021	Fines
<b>05VN-079</b>	March 30	Sediment (grab)	Hand	699165.1212021	Brown, Fines
<b>05VN-080</b>	March 30	Soil (comp of 10)	Corer	699165.1212021	Brown, 30% Sand
<b>05VN-081</b>	March 30	Sediment (grab)	Hand	699157.1211899	40% Sand, 20% Gravel
05VN-082	March 30	Soil (comp of 10)	Corer	701098.1213178	30% Sand
05VN-083	March 30	Sediment (grab)	Hand	701098.1213178	Fines and Organics

<sup>1</sup> Bold denotes those samples submitted for laboratory analyses.

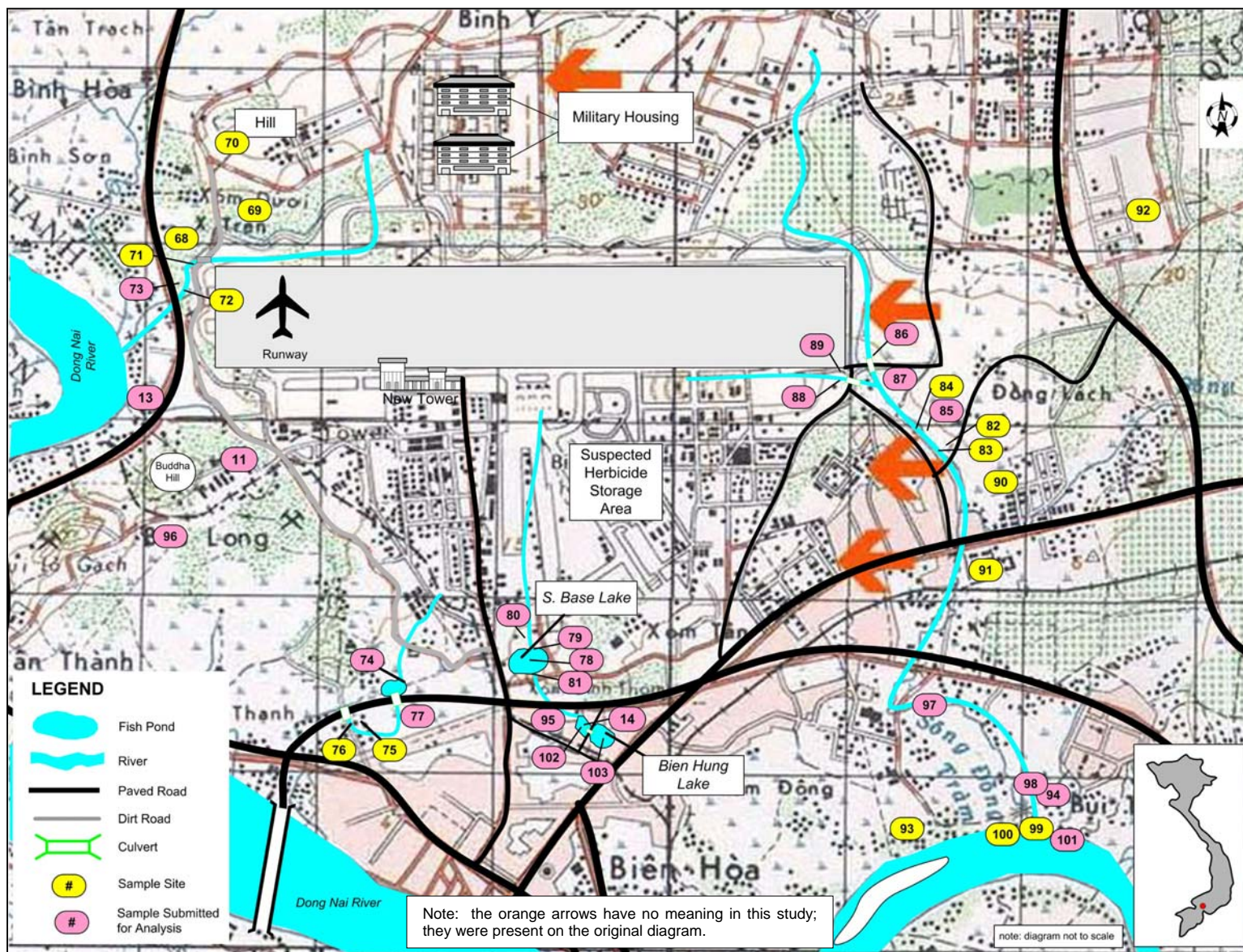
**Table 2.11 Cont'd.**

<b>Sample No.<sup>1</sup></b>	<b>Sample Date</b>	<b>Sample Type</b>	<b>Sample Method</b>	<b>Sample Coordinates</b>	<b>Sample Description</b>
05VN-084	March 30	Soil (comp of 10)	Corer	700949.1213371	20% Sand
<b>05VN-085</b>	March 30	Sediment (grab)	Hand	700957.1213468	Fines
<b>05VN-086</b>	March 31	Sediment (grab)	Hand	700777.1213665	Fines
<b>05VN-087</b>	March 31	Soil (comp of 10)	Corer	700961.1213566	Fines
<b>05VN-088</b>	March 31	Sediment (grab)	Hand	700725.1213592	
<b>05VN-089</b>	March 31	Soil (comp of 10)	Corer	700725.1213592	Fines
05VN-090	March 31	Soil (comp of 10)	Corer	701341.1213218	Brown Fines
05VN-091	March 31	Soil (comp of 10)	Corer	701579.1212464	Loam
05VN-092	March 31	Soil (comp of 10)	Corer	702474.1214265	Reddish Fines
05VN-093	March 31	Sediment (grab)	Hand	701547.1211541	Dark Fines
<b>05VN-094</b>	March 31	Sediment (grab)	Hand	701583.1211234	Dark Grey Fines
<b>05VN-095</b>	April 1	Soil (comp of 10)	Trowel	698907.1211511	Grey/Brown 10% Sand
<b>05VN-096</b>	April 1	Soil (comp of 10)	Corer	696581.1211855	Light Brown Loam
<b>05VN-097</b>	March 31	Sediment (grab)	Hand	700978.1211889	Black Fines
<b>05VN-098</b>	March 31	Sediment (grab)	Hand	701599.1211164	Grey Fines
05VN-099	March 31	Sediment (grab)	Hand	701652.1211010	Black/Grey/Brown
05VN-100	March 31	Sediment (grab)	Hand	701560.1210998	
<b>05VN-101</b>	March 31	Sediment (grab)	Hand	701698.1210987	Black Fines
<b>05VN-102</b>	March 31	Sediment (grab)	Hand	698852.1211444	Black Fines
<b>05VN-103</b>	March 31	Sediment (grab)	Hand	698933.1211416	Grey

<sup>1</sup> Bold denotes those samples submitted for laboratory analyses.



**Figure 2.9 US military map of Bien Hoa showing key features and sample locations from the April 2005 Phase II field program.**





**Figure 2.10 2003 Ikonos image of the Bien Hoa area, Dang Nai Province (2003).**



#### **2.5.5.6 Can Tho (Appendix A3.6)**

##### ***Rationale for Selection***

Can Tho (Can Tho City), situated in the middle of the Mekong Delta, was the primary Ranch Hand and herbicide spraying program location in the IV Corps (Mekong Delta) zone. Agent Orange use was suspected to be heavy, as Can Tho was used as a staging area for defoliation of Ca Mau and other southern coastal areas. In personal communications, Vietnamese chemical corps personnel indicated that the Vietnamese military have already employed some level of dioxin mitigation measures for sediments in and around the base. These mitigation features or procedures were not observed during the Phase II field visit to Can Tho.

##### ***Samples Collected***

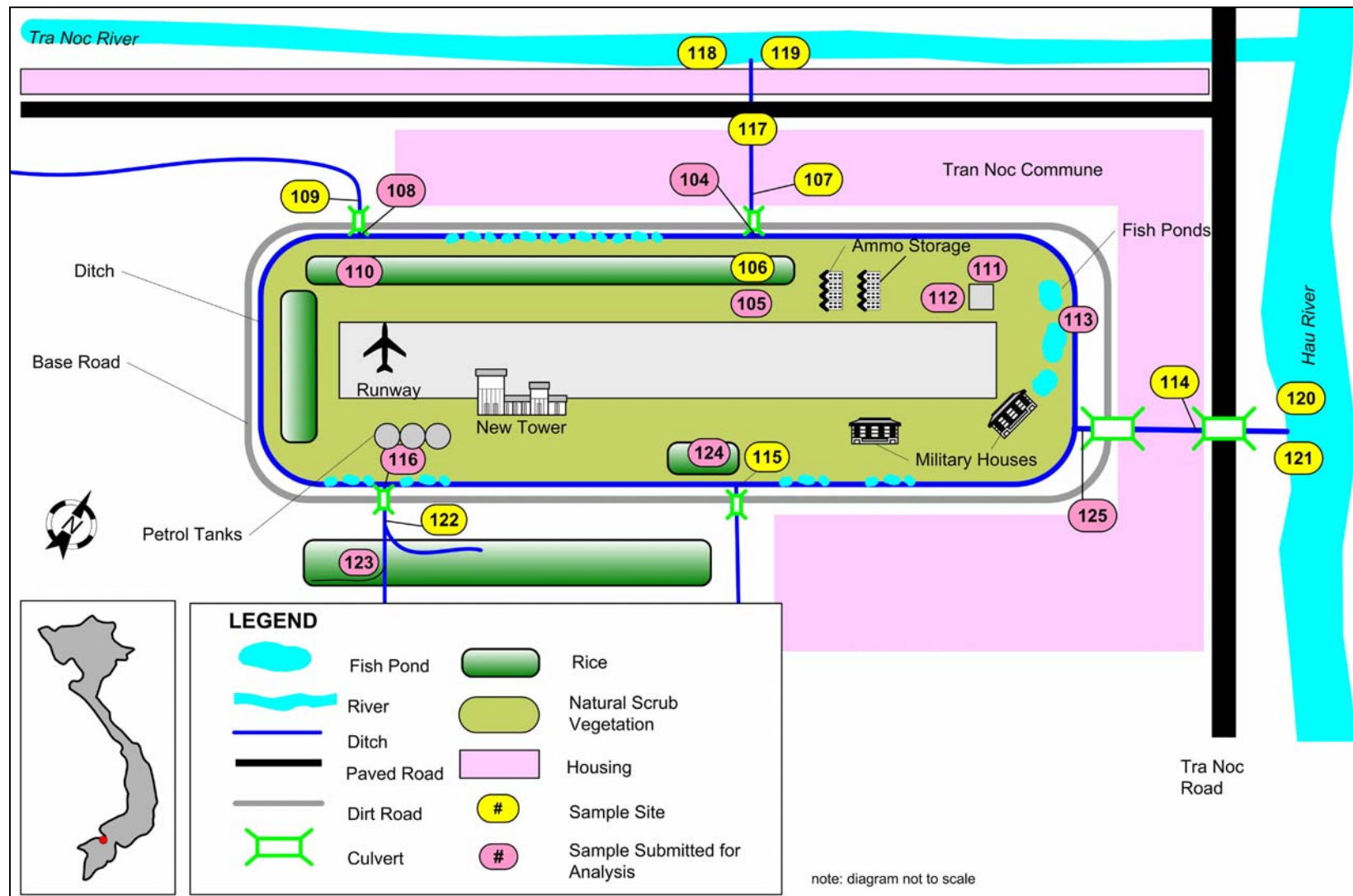
At Can Tho airbase, seven (7) soil samples and fifteen (15) sediment samples were collected on and around the airbase property (Table 2.12 and Figure 2.11).

**Table 2.12 Samples collected at Can Tho airbase, March 2005.**

<b>Sample No. <sup>1</sup></b>	<b>Sample Date</b>	<b>Sample Type</b>	<b>Sample Method</b>	<b>Sample Coordinates</b>	<b>Sample Description</b>
<b>05VN-104</b>	April 3	Soil (comp of 10)	Corer	578250.1115370	Brown, Fines
<b>05VN-105</b>	April 3	Sediment (grab)	Hand	578330.1115177	Fines
05VN-106	April 3	Soil (comp of 10)	Corer	578274.1115264	Fines
05VN-107	April 3	Sediment (grab)	Hand	578221.1115316	Brown, Fines
<b>05VN-108</b>	April 3	Sediment (grab)	Hand	577108.1114648	Brown, Fines
05VN-109	April 3	Sediment (grab)	Hand	577082.1114642	Brown, Fines
<b>05VN-110</b>	April 3	Soil (comp of 10)	Corer	577141.1114567	Fines
<b>05VN-111</b>	April 3	Soil (comp of 10)	Corer	579102.1115743	Dark Brown, Fines
<b>05VN-112</b>	April 3	Soil (comp of 10)	Corer	579078.1115679	Light Brown, Fines
<b>05VN-113</b>	April 3	Sediment (grab)	Hand	579223.1115812	Grey/Brown, Fines
05VN-114	April 3	Sediment (grab)	Eckman Grab	579614.1115871	
05VN-115	April 3	Sediment (grab)	Hand	579045.1133164	
<b>05VN-116</b>	April 3	Sediment (grab)	Hand	578780.1114549	
05VN-117	April 4	Sediment (grab)	Hand	578122.1115502	Brown, Fines
05VN-118	April 4	Sediment (grab)	Hand	578152.1115552	Brown, Fines
05VN-119	April 4	Sediment (grab)	Hand	578152.1115482	Brown, Fines
05VN-120	April 4	Sediment (grab)	Hand	579743.1115719	50% Sand, 50% Fines
05VN-121	April 4	Sediment (grab)	Hand	579870.1115611	50% Sand, 50% Fines
05VN-122	April 4	Sediment (grab)	Hand	578787.1114527	Fines
<b>05VN-123</b>	April 4	Soil (comp of 10)	Hand	578782.1114451	10% Sand
<b>05VN-124</b>	April 4	Soil (comp of 10)	Corer	579050.1114735	
<b>05VN-125</b>	April 4	Soil (comp of 10)	Hand	579583.1115514	

<sup>1</sup> Bold denotes those samples submitted for laboratory analyses.

**Figure 2.11 Sketch map of Can Tho (Can Tho City) showing key features and sample locations from the April 2005 Phase II field program.**





Can Tho has an extensive drainage ditch system surrounding the base, and local residents use property on the base to raise fish and cultivate rice, fruit, and vegetables. Human contact with soils and sediments in and around the base is very high for farmers and fish growers. Interviews with local inhabitants indicated that further exploitation of airbase land is planned in the near future. An Earthsat satellite image taken in 2000 of Can Tho airbase and surrounding area is provided in Figure 2.12.

**Figure 2.12 EarthSat satellite image of Can Tho airbase, 2000.**



### 2.5.5.7 Tan Son Nhut (Appendix A3.7)

#### ***Rationale for Selection***

Tan Son Nhut (Ho Chi Minh City) was the first location chosen for Operation Ranch Hand activities during the American/Viet Nam conflict. Within the Tan Son Nhut airbase boundary, Operation Ranch Hand was located in Charlie Sector. Early on in Operation Ranch Hand, the United States Military experimented with different types of herbicide, including Agent Purple. Agent Purple was chosen primarily for its rice crop destruction characteristics. Although abandoned early as a defoliant, Agent Purple was stored and loaded at Tan Son Nhut. Agent Purple contained much higher levels of dioxin compared to Agent Orange (Cecil 1986).

#### ***Samples Collected***

At the Tan Son Nhut site, three (3) sediment samples and one (1) soil sample were collected on airbase property. Two sediment samples (one ditch and one pond) were collected near the existing airstrip in a drainage system that flows northwest from the airstrip. Two additional samples were collected at the former Operation Ranch Hand site in what was Charlie Sector during American occupation (Table 2.13 and Figure 2.13). As access to Tan Son Nhut was restricted to foreigners, Vietnamese team members collected all samples.

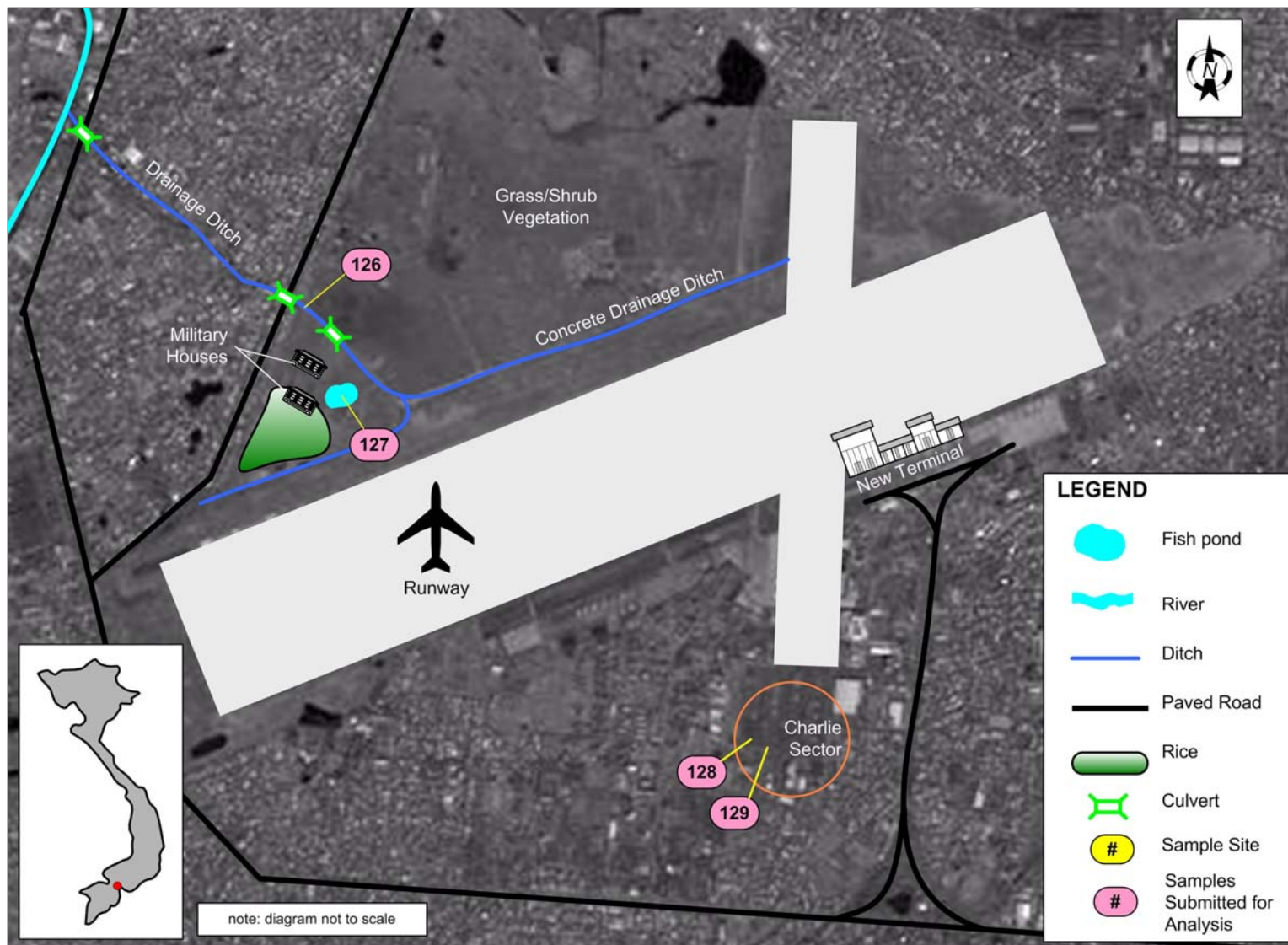
**Table 2.13 Samples collected at Tan Son Nhut airbase, March 2005.**

<b>Sample No. <sup>1</sup></b>	<b>Sample Date</b>	<b>Sample Type</b>	<b>Sample Method</b>	<b>Sample Coordinates</b>	<b>Sample Description</b>
<b>05VN-126</b>	April 6	Sediment (grab)	Hand	679394.1197026	10% Sand, Brown/Black
<b>05VN-127</b>	April 6	Sediment (grab)	Hand	670480.1196614	10% Sand, Brown/Black
<b>05VN-128</b>	April 6	Sediment (grab)	Hand	681383.1195660	10% Sand, Brown/Black
<b>05VN-129</b>	April 6	Soil (comp of 10)	Trowel	681383.1195600	20% Sand, Yellow

<sup>1</sup> Bold denotes those samples submitted for laboratory analyses.

The boundaries of the airport have not significantly changed in the 30 years since the end of the war. However, population density around the base has greatly increased raising concerns regarding potential human contact with potentially contaminated soils and sediments around Tan Son Nhut.

**Figure 2.13** Ikonos image (2001) of Tan Son Nhut (Ho Chi Minh City) overlaid with key features and sample locations from the April 2005 Phase II field program.



### 2.5.6 Laboratory Analyses

Soil/sediment samples from Viet Nam were forwarded (in a frozen state) to AXYS Analytical Services, Sydney, British Columbia (BC), Canada. Fifty-nine samples were selected for a first round of dioxin analyses based on the potential of these samples to be located within suspected dioxin hot spots. Subsequent to receipt of results from the first round of analysis, an additional 34 samples were submitted for testing; these were selected on the basis of 'fine tuning' the potential contaminated area for a given military base, and filling in data gaps in suspected areas.

In general, the sample selection protocol focused on sites that had a relatively high probability for human health impacts, based on a risk-based assessment for each region. According to the risk-based approach, potential for human contamination may depend upon either high contamination at a source, a clear pathway from source to receptor, and/or a receptor that may be particularly susceptible to the contaminant. Therefore, areas of high potential contamination (i.e., Agent Orange storage or loading areas), clear pathway identification to human contact (i.e., drainages leading from Agent Orange storage/loading areas), and areas of high potential for human contact (i.e., densely populated areas or agrarian areas where human/soil contact is high) were chosen for analysis.

All soil and sediment samples being tested for polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) were spiked with C-labelled surrogate standards (tetrachlorodioxin, tetrachlorofuran, pentachlorodioxin, pentachlorofuran, hexachlorodioxin, hexachlorofuran, heptachlorodioxin heptachlorofuran, and octachlorodioxin) prior to analysis. Soil samples were soxhlet extracted. Samples were liquid/liquid extracted by shaking with solvent. All extracts were subject to a series of chromatographic cleanup steps prior to analysis for PCDDs and PCDFs by high resolution gas chromatography with high resolution mass spectrometric detection (HRGC/HRMS).

The AXYS laboratory quality assurance/quality control (QA/QC) program included matrix specific method recovery studies, verification of standard solution accuracy against recognized standard reference solutions, analysis of certified reference materials, and participation in interlaboratory comparison programs.

The accuracy of 2,3,7,8-TCDD in the standard solutions used for analysis was verified against NIST SRM 1614 (National Institute of Standards & Technology – Standard Reference Material 1614); the accuracy of other 2,3,7,8-substituted PCDD and PCDF congeners was verified against a standard reference solution characterized by interlaboratory testing (12 independent labs). The program of interlaboratory testing includes participation in studies organized by the University of Umea, the WHO, QUASIMEME (inter-laboratory performance

study: Quality Assurance of Information for Marine Environmental Monitoring in Europe), and Environment Canada encompassing sediment, tissue, milk, and blood samples.

Samples were analyzed in batches alongside QC samples. Each analysis batch included a laboratory blank to demonstrate acceptable laboratory background levels, a spiked matrix reference sample to demonstrate analyte recoveries, and a duplicate sample (sample size permitting) to demonstrate the analytical precision achieved. The results for the batch QC samples must fall within predefined acceptance limits for the sample data to be accepted. On-going evaluation of QC sample data was conducted to ensure the analytical system was operating in a state of control. As part of their QA/QC program, AXYS will periodically perform 'duplicate' analyses on a sample from a given analytical run if the number of individual analyses is greater than 10. This is done to confirm consistency in the analytical run.

Total toxic equivalents (TEQ) for each sample analyzed were calculated in the laboratory using the revised World Health Organization (WHO) Toxic Equivalency Factors (TEFs) for PCDDs and PCDFs (Van den Berg *et al.*, 1998). For non-detectable (ND) and NDR (chromatographic peak was detected, but did not meet quantification criteria) designations, half the detection limit of the sample was used in the total TEQ calculation.

## **3.0 RESULTS AND DISCUSSION**

### **3.1 PERSPECTIVE**

Detailed results of dioxin analyses for soil and sediment samples collected during the Ford Foundation Hot Spot Project are presented as raw laboratory data sheets in Appendix A4 (i.e., Appendix A4.1 through A4.7). Appendix A4.8 summarizes the QA/QC information for the analyses.

For purposes of discussion, results from each former US military installation will be presented individually through summary tables and figures. A brief overview is presented on soil/sediment dioxin and public health issues for each site. In addition, a review of historical dioxin data for soils/sediments in Viet Nam is presented. These sections are intended to provide the reader with some points of reference regarding guideline (regulatory) levels for dioxins in soils that exist in some countries, thereby enabling the placement of 2005 Viet Nam data into some practical context.

In most cases, historical information was lacking as to the exact location of the storage and dispensation points for Agent Orange and other herbicides on each base. In some instances, 'suspected' sites were identified through discussions and personal communications with Vietnamese military personnel. The field collection crew was generally not permitted to visit sites that were 'off-limits', as set by Vietnamese authorities, given that these areas are active military bases. Sampling in these circumstances was undertaken 'downstream' of a suspect hot spot area; sampling therefore concentrated on dioxin residues that may have been carried downstream of the primary site of suspected contamination. Topographical features were considered in the sample collection design to identify areas with a relatively high probability of being downstream of a suspected primary area of contamination. Consequently, as a result of limited site-specific information on wartime infrastructure, the dioxin levels reported here should be considered 'indicators' of the probability for primary contamination on a given base.

### **3.2 SOIL/SEDIMENT DIOXIN GUIDELINES AND PUBLIC HEALTH**

Dioxins in general, and TCDD in particular, in soils from industrialized countries are expected to be detected at varying concentrations. The production of dioxin and dioxin-like compounds (e.g., PCBs) essentially began during World War I as a result of large-scale industrialization (Webster and Commoner, 1994).

Historically, soils near specific industries and certain material treatment processes have a high probability of containing dioxins, particularly if chlorine was involved in the process (e.g., bleaching of pulp and paper with elemental chlorine; incineration of chemical waste, hospital waste and sewage sludge; processing of certain metals) (Webster and Commoner, 1994).



Given their low water solubility and resistance to rapid degradation, dioxins (particularly TCDD) tend to partition into soil; consequently, this medium serves as a "reservoir" for the contaminant, and effectively serves to facilitate the contamination of other media long after cessation of an activity and/or process has occurred.

In the United States, the ATSDR (1998) reports that TCDD is not generally detected in rural soils; however, in industrialized regions of the US, TCDD levels typically range from 1.0 pg/g to 10 pg/g. The International Agency for Research on Cancer (IARC, 1997) provides a detailed summary of 42 studies in 18 industrialized countries, presenting over 150 TCDD data points. TCDD concentrations presented in this overview ranged from ND to  $9.6 \times 10^9$  pg/g; the highest concentrations recorded in the IARC (1997) summary were found in highly contaminated soils from Missouri (e.g., a horse arena and farm soil, Kimbrough *et al.*, 1997 and Viswanthan *et al.*, 1995, both cited in IARC, 1997). Other very high TCDD levels (i.e., >1,000 pg/g) were recorded in soils collected from heavily industrialized sites; these sites included manufacturing plants for tetrachlorophenol, pentachlorophenol, chlorophenolics and herbicides (e.g., 2,4-D) and incineration facilities.

Regulatory agencies addressing human health protection have employed various protocols to address the issue of dioxin contamination (e.g., in Canada, Health Canada and provincial health ministries and environmental departments; in the US, the Environmental Protection Agency [EPA] and state health agencies).

In British Columbia (BC), Canada, legislation addresses the issues of contaminated sites and legal standards directed at site remediation. The definition of a "contaminated site" (i.e., soil) in BC is one in which:

*"...the concentration of any substance in the soil at the site is greater than or equal to... the lowest value of the applicable matrix numerical soil standards..."* (BC Waste Management Act 1996).

For soils contaminated with polychlorinated dioxins and polychlorinated furans (PCDD and PCDF, respectively), legal T-TEQ standards are set, which if exceeded, would designate a site to be a "contaminated site". For example, in BC, the land categories of "agricultural and residential/park" are recognized in the legislation. The site-specific receptors that define the legal threshold contaminant level for the land categories considered above are "human health protection" and "environmental protection" (i.e., ecological health). The following is the BC PCDD/PCDF (expressed as T-TEQ) soil standards for agricultural and residential/park soils (source: BC Waste Management Act, 1996):

### Matrix Numerical Soil Standard (pg/g Total TEQ).

Site-Specific Factor/Receptor	Agricultural Land	Residential/Park Land
Human Health Protection <sup>1</sup>	350	350
Environmental Protection	10	1,000

<sup>1</sup> An adult is used as the critical receptor, and related to intake (ingestion) of contaminated soil.

When addressing the issue of ecological health (environmental protection), the agricultural land and residential/park categories have different levels, 10 pg/g and 1,000 pg/g T-TEQ, respectively.

When addressing human health protection in BC, T-TEQ for agricultural and residential/park soils is 350 pg/g for both categories. This value is calculated on the basis of oral ingestion of soils alone, and does not make provision for dioxins that may be taken into the body through other avenues (e.g., foods, drinking water, exposure to commercial products; BC Environment, 1996).

The above values focus on adult individuals with an assumed soil ingestion rate of 20 mg/day (BC Environment, 1996). The following table provides a summation of typical soil ingestion rates for the general population in Canada (source: Angus Environmental, 1991; Newhook, 1992 and MENVIQ, 1992, *cited in* BC Environment, 1996):

#### Typical Average Receptor Characteristic Values for the Canadian General Population.

Age Classes (years)	Soil Intake (mg/day)
0-0.5	20
0.6-4	80
5-11	20
12-19	20
20+	20

It should be noted here that young children are believed to ingest more soil materials and, generally, have greater exposure to soil contaminants relative to adults. Their lower body weight is also a factor.

When a given area is to be assessed and categorized as to whether or not it constitutes a contaminated site in BC, two receptor categories (human health and ecological health, see above table) are always considered. However, if a land category is designated as contaminated by either standard, and remediation is contemplated, the BC Waste Management Act (1996) stipulates that the "lowest" matrix numerical soil standard be applied; that is, if a property is to be remediated



for agricultural purposes, the 10 pg/g T-TEQ level for PCDDs/PCDFs is the target (remediation measures must reduce the soil contaminate level below 10 pg/g T-TEQ). Similarly, if land is to be remediated solely for the purposes of residential/park use, 350 pg/g T-TEQ is the target criterion.

The question may be posed: if the ecological health receptor level is 10 pg/g T-TEQ for agricultural land, and the human health receptor level is 350 pg/g T-TEQ, is not more importance being placed on the ecological elements as opposed to human elements of the environment? The rationale for the difference in T-TEQ relates to the issues of bioaccumulation and biomagnification. Agricultural areas are used for raising food (crops and livestock); these foods are ultimately consumed by humans, therefore, directly facilitating dioxin bioaccumulation and biomagnification processes. Since it is important to protect crops, livestock, and human health, a more stringent standard has been designated for ecological health.

A similar rationale is in place for residential/park lands. Given that residential/park areas are not major food producing regions, the ecological health standard is set at 1000 pg/g T-TEQ. The direct ingestion of soil contaminants is considered a greater probability (and greater potential hazard) in residential/park situations relative to the possibility of ingestion from foods produced in these areas. The quantity of foods produced in a residential/park area is markedly less than on agricultural lands, hence the 1000 pg/g and 10 pg/g levels, respectively.

The Canadian Council of Ministers of the Environment (CCME, 1999), a joint federal-provincial Canadian agency, has set a guideline for PCDDs and PCDFs (T-TEQ) for land used in agricultural areas at 10 pg/g T-TEQ, and for residential/park land at 1000 pg/g T-TEQ; only a single value is presented for each land category. In Canadian provinces, where contaminated site legislation is available, the provincial regulatory standards take precedence over CCME guidelines. The CCME (1999) T-TEQ values for agricultural and residential/park land use are recommended for remediation quality (i.e., remediation should be equal to or less than these values).

Canada, in general, and as a federal jurisdiction, has a residential soil criterion of 4 pg/g TEQ. However, if provinces have established set guidelines for dioxin, these take precedence over the national guideline.

In the US, the Environmental Protection Agency (EPA) works to protect public health and the environment. Regarding soils and contaminant levels, for example, the US EPA Region III (Delaware, Maryland, Pennsylvania, Virginia, West Virginia and District of Columbia) has set a TCDD level (not T-TEQ level as in BC, Canada) of 4.3 pg/g as a residential soil guideline (a level for agricultural soil does not exist) and 38.0 pg/g for industrial soil (US EPA, 1999a). If soil values exceed these guidelines, a risk assessment is required.

In US EPA Region IX (Arizona, California, Nevada, Hawaii, US Territories of Guam and American Samoa, and the Commonwealth of the Northern Mariana Islands, and other unincorporated US Pacific possessions), the soil guidelines for TCDD are 3.9 pg/g and 27 pg/g for residential and industrial soils, respectively (US EPA, 1999b).

Some differences related to assumed dioxin exposure, and thus guideline values, exist between Regions III and IX; however, it can be accepted that the residential soil guideline is relatively low (4.3 pg/g and 3.9 pg/g TCDD, respectively).

The 'federal' guideline for the USEPA is 1000 pg/g TEQ as a remediation goal.

The ATSDR (1997) guideline for dioxin and dioxin-like compounds in residential soils has been set at 50 pg/g T-TEQ. The guideline states that in residential regions where soil T-TEQ levels exceed 50 pg/g, a further site-specific evaluation is required. The ATSDR (1997) indicates that if a soil dioxin level is <50 pg/g T-TEQ, a more detailed site-specific assessment may still be required based on overall community health concerns and a health assessor's concerns regarding other combinations of potential contaminants. In addition, if an exposure pathway is identified as in a food chain pathway, the extent of exposure and public health implications are required to be further evaluated. The likelihood, frequency, routes and exposure levels to the contaminant, and information on human populations that are exposed, would require assessment.

The ATSDR (1997) guideline recommends that an area with a soil concentration of >50 pg/g to <1,000 pg/g T-TEQ should experience the following evaluation:

- bioavailability;
- ingestion rates;
- pathway analyses;
- soil cover;
- climate;
- other contaminants;
- community concerns;
- demographics; and
- background exposures.

ATSDR (1997) also recommends that if soil levels are  $\geq 1000$  pg/g T-TEQ, public health actions should be considered, such as:

- surveillance;
- research;

- health studies;
- community;
- education, and
- exposure investigations.

Essentially, health assessors should obtain a sufficiently detailed database to enable a judgment regarding assessment of the site as a public health hazard, thereby facilitating implementation of public health recommendations to prevent human exposure, which includes clean-up of the contaminated site.

Germany has set a soil dioxin guideline for playgrounds at 100 pg/g TEQ and for residential soils at 1,000 pg/g TEQ (NZMOE, 2002). In Japan, if a soil dioxin level exceeds 250 pg/g TEQ, investigations must be undertaken to protect human health. Finland has established 500 pg/g TEQ as the residential soil guideline, and 2.0 pg/g TEQ level for protection of humans (NZMOE, 2002). Sweden has addressed lands with 'sensitive use' (presumably related to close human contact) with a guideline of 10 pg/g TEQ, and for soils with 'less sensitive use' of 250 pg/g TEQ. The province of Alberta (Canada) has set 1000 pg/g TEQ as the remediation goal for dioxins (Alberta Environment, 1994). The Netherlands has established a level of 10 pg/g TEQ for animal grazing soils and 1000 pg/g TEQ for residential soils (NZMOE, 2002).

Table 3.1 summarizes the various soil dioxin criteria over numerous jurisdictions throughout the world. Finland appears to have the most stringent guideline, this being for protection of human health (i.e., 2 pg/g TEQ). Residential soil guidelines range from 4 pg/g TEQ in Canada (Federal) to 1000 pg/g TEQ in the Netherlands and Germany, with values of 10 pg/g TEQ in Sweden and 350 pg/g TEQ in the province of British Columbia (Canada). It is interesting to note that the ATSDR (1997) advocates specific studies (i.e., Evaluation Level) if dioxin TEQ is >50 but < 1000 pg/g.

Dioxins in soil can pose a lingering threat to human health. Paustenbach *et al.* (1992) has indicated that the half-life of dioxins in subsurface soils can extend to 100 years. Therefore, any substantial disturbance of the integrity of soil layers has the potential of re-mobilizing dioxin, and ultimately may lead to its introduction into the human food chain.

**Table 3.1 Summary of dioxin (TCDD and TCDD TEQ) criteria for soil (dry weight basis).**

Country/Jurisdiction	Guideline	Comments
Germany <sup>1,2</sup>	5 pg/g TEQ	Agricultural soils.
	100 pg/g TEQ	Playground soils.
	1000 pg/g TEQ	Residential soils.
Japan <sup>2</sup>	250 pg/g TEQ	If exceeded, research studies required.
	1000 pg/g TEQ	If exceeded, removal required.
Canada (Federal) <sup>2</sup>	4 pg/g TEQ	Agricultural (ecological health). Residential (human health).
British Columbia, Canada <sup>3</sup> (Provincial)	10 pg/g TEQ	Agricultural
	350 pg/g TEQ	Residential
Alberta, Canada <sup>4</sup> (Provincial)	1000 pg/g TEQ	If exceeded, remediation required.
USEPA (Federal) <sup>2</sup>	1000 pg/g TEQ	Remediation goal.
USEPA, Region 3 <sup>5</sup>	4.3 pg/g TCDD	Residential soils, if exceeded, risk assessment required.
	38.0 pg/g TCDD	Industrial soils, if exceeded, risk assessment required.
USEPA, Region 6 <sup>2</sup> & 9 <sup>6</sup>	3.9 pg/g TCDD	Residential soils, if exceeded, risk assessment required.
Region 9 <sup>6</sup>	27.0 pg/g TCDD	Industrial soils, if exceeded, risk assessment required.
ATSDR <sup>7</sup>	≤50 pg/g TEQ	Screening level.
	>50 - <1000 TEQ	Evaluation level.
	≥1000 pg/g TEQ	Action level.
Canada <sup>8</sup>	10 pg/g TEQ	Agricultural soils.
	1000 pg/g TEQ	Residential/park land soils.
Sweden <sup>2</sup>	10 pg/g TEQ	Residential soils.
	250 pg/g TEQ	Industrial soils.
Netherlands <sup>2</sup>	10 pg/g TEQ	Animal grazing lands (agricultural).
	1000 pg/g TEQ	Residential soils.
Finland <sup>1,2</sup>	2 pg/g TEQ	Protection of humans.
	500 pg/g TEQ	Limit for contaminated soils.

<sup>1</sup> AEA Technology, 1999.

<sup>2</sup> NZMOE, 2002.

<sup>3</sup> BCWMA, 1996.

<sup>4</sup> Alberta Environment, 1994.

<sup>5</sup> USEPA, 1999a.

<sup>6</sup> USEPA, 1999b.

<sup>7</sup> ATSDR, 1997.

<sup>8</sup> CCME, 1999.

Aquatic sediments, in a variety of jurisdictions have proposed guidelines regarding dioxins. These levels range from 1 pg/g TEQ in the Wisconsin Dept. of Natural Resources, to 100 pg/g TEQ in the Netherlands and New York Dept. of Environmental Conservation (AEA Technology, 1999). Germany, Environment Canada and the Great Lakes Science Advisory Board have set 10 pg/g TEQ as the level for protection of human and ecological receptors (AEA Technology, 1999).

Table 3.3 summarizes proposed sediment dioxin guidelines in a number of jurisdictions.

**Table 3.2 Proposed dioxin guidelines (TCDD TEQ) in aquatic sediments (dry weight basis).**

Country/Jurisdiction	Guideline	Comments
USEPA, Region 10 <sup>1</sup>	4 pg/g TEQ	Protection of human and ecological receptors.
New York State Dept. of Environmental Conservation <sup>1</sup>	10-100 pg/g TEQ	Protection of human and ecological receptors.
Wisconsin Dept. of Natural Resources <sup>1</sup>	1 pg/g TEQ	Protection of human receptors.
Int. Joint Comm., Great Lakes Science Advisory Board <sup>1</sup>	10 pg/g TEQ	Protection of human and ecological receptors.
Canada <sup>2</sup>	21.5 pg/g TEQ	Above this value, adverse ecological effects likely.
Environment Canada, Pacific Yukon Region <sup>1</sup>	10 pg/g TEQ	Protection of ecological receptors.
Germany – Hamburg Dept. of Environment <sup>1</sup>	5-10 pg/g TEQ	Protection of human receptors.
Netherlands <sup>1</sup>	100 pg/g TEQ	Protection of human receptors (threshold for remediation).

<sup>1</sup> AEA Technology, 1999.

<sup>2</sup> CCME, 1999.

### 3.3 SOIL/SEDIMENT DIOXIN IN VIET NAM – A BRIEF REVIEW

In the region of Vung Tao during the war, herbicides were applied by C123 aircraft. Hatfield Consultants Ltd. (2001) were contracted to sample and test soils for dioxin in the area of a proposed industrial development. TCDD levels ranged from non-detect to a maximum of 3.3 pg/g. In general, low levels of dioxin contamination were recorded throughout the study area.

Schecter *et al.* (2001) reported very high levels of TCDD from three soil samples collected near Bien Hoa (1.2 million pg/g, 604,000 pg/g, and 10,600 pg/g). Bien Hoa was a former Operation Ranch Hand base. Although the values reported are very high, no information is presented as to exactly where these high samples originated. Without having geographical positioning, the value of these data is significantly diminished with regard to future mitigation/remediation.

Hatfield Consultants Ltd. (2000a) also undertook soil sampling in Quang Tri Province near Dong Ha. TCDD levels were very low ranging from non-detect to 2.1 pg/g.

The highest soil concentrations of TCDD in the Aluoi Valley (Hatfield and 10-80 Committee, 1998), apart from the former airbase locations, were detected in farmer's field soil (10-30 cm depth) in 1996 (4.4 pg/g) and manioc field soil (0-10 cm depth) in 1997 (6.61 pg/g). A level of 4.2 pg/g was detected in 1997 from a ploughed field. Other soils (non airbase) in 1996 exhibited TCDD from non-detect levels to 1.7 pg/g with comparably low TEQ values. Soils from the Ma Da forest area yielded 19.1 pg/g of TCDD.

Matsuda *et al.* (1994) reported soil levels of TCDD from various regions of southern Viet Nam. A total of 106 soil samples were collected over four sampling periods between 1989 and 1991. When detected, TCDD levels ranged from 1.2 pg/g to 59 pg/g (detection level 1.0 pg/g). Only 21 of the 106 samples yielded detectable levels of TCDD. They concluded that leaching and run-off contributed to the gradual removal of the compound from surface soils. They also indicated that dioxin could not be detected in soils at depths greater than 10 cm. However, Hatfield and 10-80 Committee (1998) showed that the TCDD congener can be present in soil depths greater than 10 cm.

Quynh *et al.* (1994) also reported TCDD in Viet Nam soils. A 1985 sample from the Aluoi Valley yielded 1.0 pg/g at a depth of 20 cm. In 1990 they reported a value of 62.7 pg/g at a depth of 10 cm near Bac Ma which is situated between Hue and Da Nang; the 10-20 cm depth fraction exhibited a TCDD value of 17.3 pg/g.

Hatfield and 10-80 Committee (1998, 2000) data and other research supports the contention that those areas which had received aerial applications of Agent Orange now yield relatively low soil levels of dioxin. The natural influences of leaching, chemical decomposition, run-off and tropical rains have likely dispersed/degraded the compound over time.

High concentrations of TCDD were detected at the former US airbase at A So in Aluoi Valley, Thua Thein Hue Province (Hatfield and 10-80 Committee, 2000). Significant contamination was reported, both in 1996 and 1997, particularly at the 0-10 cm depth level (100 pg/g and 897.85 pg/g, respectively). It would appear that airbases had potential for significant soil contamination during the conflict by virtue of their role as a storage and dispensation point for Agent Orange and other herbicides.

Hatfield and 10-80 Committee (2000) data and historical information from Bien Hoa suggest that former US airbases, whether they have been totally abandoned or are presently being used by the Vietnamese military, have high potential for significant soil contamination. Other former US or allied army, navy and marine bases could also have contaminated soils since Agent Orange ground and

helicopter spraying occurred around virtually all installations during the war. Regions in close proximity to these bases may also exhibit elevated contaminant levels due to the configuration of drainage patterns in the area.

Schecter *et al.* (2001) summarized TCDD levels in sediments from Bien Hung Lakes and the Dong Nai River near Bien Hoa. Their TCDD values ranged from 0.8 pg/g to 177 pg/g. They concluded that the high levels of TCDD in their investigation may be related to the spill of Agent Orange on the Bien Hoa base in 1970.

In the Aluoi Valley (Hatfield and 10-80 Committee 1998, 2000), only one bottom sediment sample was collected from the A Sap River in a depositional zone of the river. A TCDD level of 0.8 pg/g was detected.

Quynh *et al.* (1994) reported non-detectable levels of dioxin in silt samples collected from the Dong Nai River and the Hong River in 1985. However, a level of 231 pg/g of TCDD was detected in sediments from a canal off the Saigon River in the centre of Ho Chi Minh City. Given that no spraying of herbicides occurred in Ho Chi Minh City, they concluded that transport and deposition of particulates from upstream-sprayed areas was responsible for levels observed within Ho Chi Minh City proper. Deposition of sediment layers over time could render these contaminants relatively inaccessible.

Fishponds in the Aluoi Valley were excavated out of the local landscape and ultimately used to provide an additional source of protein to local inhabitants. Old bomb craters are sometimes used. Fish are cultured to a harvestable age in these ponds and distributed throughout the valley through local markets.

One pond at A So exhibited the highest sediment TCDD value (6.9 pg/g) of three fishponds sampled in 1996 (Hatfield and 10-80 Committee, 1998). This pond produced a carp with high TCDD (34.0 ppt) in fat tissues. It was these tissue data in 1996 that precipitated a further examination of fishponds and resident fish tissues during the 1997 program. In 1997, four ponds were sampled in the A So commune. TCDD sediment levels ranged from 1.8 to 8.5 pg/g.

The historical dioxin database (pre-1995) for soils and sediments in Viet Nam is relatively limited and, for the most part, descriptive of samples randomly taken throughout Viet Nam. A more systematic approach was implemented by Hatfield and 10-80 Committee (1998, 2000) in attempts to compare dioxin levels in aerially sprayed regions and soils from discrete geographical areas (that is, former US military installations in the Aluoi Valley). Data gathered to date in Aluoi Valley and Bien Hoa suggest that sprayed areas of southern Viet Nam should be given secondary priority, and that priority be afforded to former US military bases when documenting dioxin contamination and progressing towards remediation.

### 3.4 DIOXIN CONTAMINATION ON THE FORMER US AIR BASES

In order to present information on each of the seven bases, a separate overview of each is presented, including data on all of the polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) found in soil and sediment samples. These data are further summarized into 2,3,7,8-TCDD concentrations, TEQs and %TCDD of TEQ, which have been incorporated in location figures for each base. All raw data, in the form of laboratory analysis sheets, are presented in Appendix A4.

Dioxins and furans may enter the environment through chemical products, combustion/incineration, natural sources and industrial operations (Health Canada, 1990). It is noteworthy that virtually all of the dioxins and furans (i.e., tetra, penta, hexa, hepta and octa) can be formed from combustion/incineration. Chemical sources like 2,4,5-T in Agent Orange was a principal source for the introduction of 2,3,7,8-TCDD into the Vietnamese environment. Complex mixtures of furans can be contributed by PCB leaks and fires in equipment containing PCBs. Forest fires and volcanoes can also contribute dioxins and furans.

#### 3.4.1 Da Nang

Table 3.3 presents a summary of PCDDs and PCDFs determined in soil and sediment samples collected from the Da Nang area near the former base.

The highest absolute concentration was determined for the octa-dioxin (O8CDD) fraction, ranging from 59.9 pg/g to 42,100 pg/g. The hepta-dioxins (H7CDD) were the next most abundant congener. In terms of toxicity, the octa-dioxins possess the lowest level of toxicity, at 0.0001 times that of 2,3,7,8-TCDD (Van der Berg *et al.*, 1998). The hepta-dioxins have a toxicity rating of 0.01 times that of 2,3,7,8-TCDD. As a consequence, the contribution of these congeners, albeit relatively high in terms of absolute numbers, may not necessarily contribute significantly to overall toxicity or total TEQ.

The 2,3,7,8-TCDD data in Table 3.3 is presented in Table 3.4 (highest concentration of TCDD to lowest concentration) accompanied by TEQ and percent TCDD of TEQ. These data are plotted on Figure 3.1 in association with their sample collection locations in the Da Nang area.



**Table 3.3 Concentrations of polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) in soil and sediment (pg/g [ppt] dry weight), Da Nang, Viet Nam, 2005.**

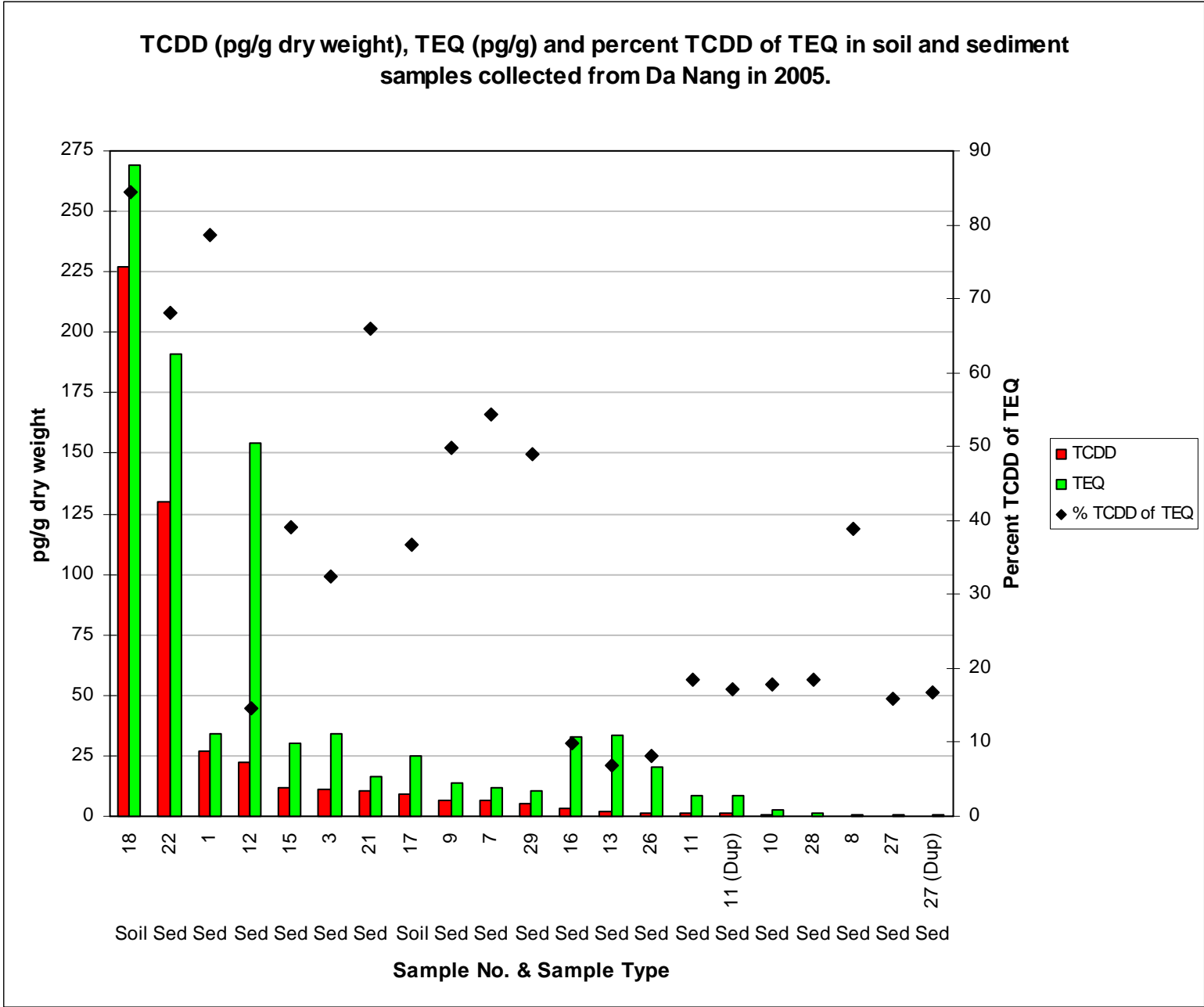
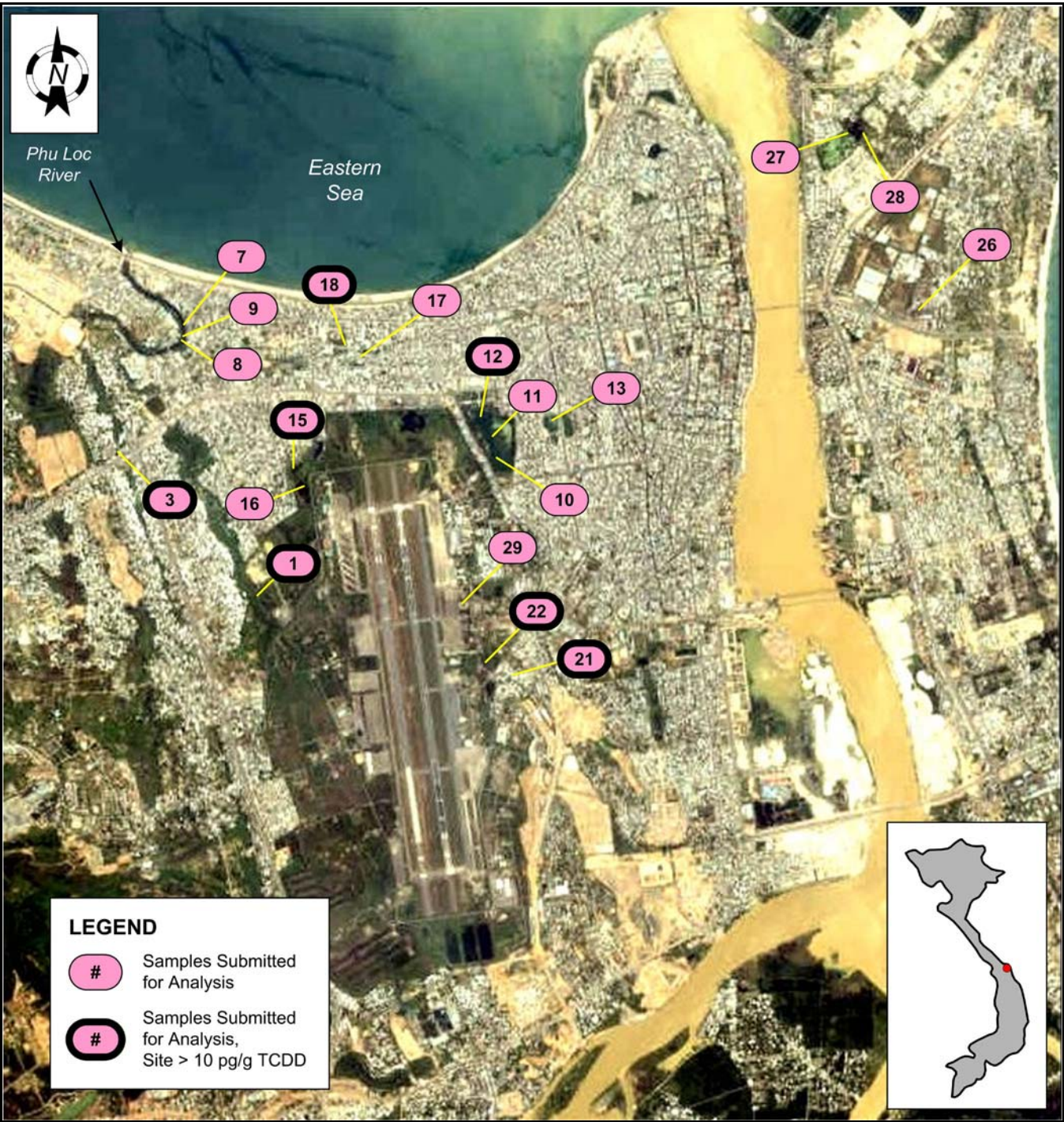
Sample ID	Sample Type	PCDD (pg/g dry weight) <sup>1</sup>						PCDF (pg/g dry weight)						Total TEQ	TCDD as % of TEQ
		2,3,7,8-TCDD	Total T4CDD	Total P5CDD	Total H6CDD	Total H7CDD	Total O8CDD	2,3,7,8-TCDF	Total T4CDF	Total P5CDF	Total H6CDF	Total H7CDF	Total O8CDF		
05VN-018	Soil	227	273	112	333	1350	8490	100	220	148	119	155	95	269	84
05VN-022	Sediment	130	187	125	660	3550	42100	29.8	204	212	277	340	203	191	68
05VN-001	Sediment	27	58.9	23.7	96.4	441	3970	1.45	12	16.3	25	31.7	21.6	34.3	79
05VN-012	Sediment	22.6	308	468	1410	5220	27400	43.8	852	853	833	754	353	154	15
05VN-015	Sediment	11.7	182	170	703	1800	17000	0.71	15.7	6.76	7.9	8.97	9.82	29.9	39
05VN-003	Sediment	11	89.2	121	551	1690	10000	5.4	35.2	37.7	57.2	71.7	40.3	34	32
05VN-021	Sediment	10.8	17.9	13.4	63.7	303	3040	0.877	13.3	15.7	21	33.8	27.2	16.4	66
05VN-017	Soil	9.06	29.8	44.5	144	620		4.67	54.5	61.3	81.6	99.2	57.5	24.7	37
05VN-009	Sediment	6.84	18.4	20.1	72.7	273	2610	3.53	30.9	26.9	30.6	38.3	26.6	13.7	50
05VN-007	Sediment	6.46	15.5	16.6	64.4	256	3130	2.61	20.1	17	22.7	30.5	23.5	11.9	54
05VN-029	Sediment	5.14	10.6	12.2	49.4	310	3650	0.986	13.8	14.4	19.5	26.6	19.2	10.5	49
05VN-016	Sediment	3.23	103	194	785	2620	24700	0.227	3.46	2.33	2.55	3.07	2.75	32.9	10
05VN-013	Sediment	2.28	709	533	1940	3420	31700	3.41	49.3	43.6	68	87.1	78.4	33.6	7
05VN-026	Sediment	1.64	25.6	81.4	198	440	1030	1.49	25.4	27.7	31.2	31	111	20.2	8
05VN-011	Sediment	1.61	16.4	23.9	92	352	2290	2.25	30.8	32.8	33.7	37.2	23.5	8.69	19
05VN-011 (Duplicate)	Sediment	1.46	15.7	23.1	92.7	345	2270	2	28.6	32.8	33.7	37.9	22.4	8.47	17
05VN-010	Sediment	0.42	3.2	5.64	17.9	59.4	486	0.43	8.27	8.48	8.89	11.5	8.8	2.34	18
05VN-028	Sediment	0.262	1.73	3.24	13.9	41.7	160	0.277	5.13	5.33	5.22	4.73	3.21	1.43	18
05VN-008	Sediment	0.175	0.987	1.11	5.32	18.1	167	0.085	0.577	0.621	1.37	2.28	1.74	0.463	38
05VN-027	Sediment	NDR 0.07	0.374	1.19	5.6	20.1	61.2	0.081	0.759	0.938	1.31	1.74	1.24	0.439	16
05VN-027 (Duplicate)	Sediment	NDR 0.07	0.351	1	5.38	20	59.9	0.073	0.694	0.792	1.26	1.65	1.33	0.418	17

<sup>1</sup> NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration. For TEQ calculation, half the detection limit of the sample was used.

**Table 3.4 2,3,7,8-TCDD (pg/g dry weight), TEQ (pg/g), and percent TCDD of the TEQ value for soil and sediment samples from Da Nang, Viet Nam, 2005.**

Sample ID	Sample Type	Location	TCDD	TEQ	% TCDD of TEQ
05VN018	soil	cultivated land	227	269	84
05VN022	sediment	ditch	130	191	68
05VN001	sediment	ditch	27	34.3	79
05VN012	sediment	Lake 29.3 (new park)	22.6	154	15
05VN015	sediment	Lake WTLD 2 (Xuan Ha Lake)	11.7	29.9	39
05VN003	sediment	ditch	11	34	32
05VN021	sediment	ditch	10.8	16.4	66
05VN017	soil	cultivated land	9.06	24.7	37
05VN009	sediment	ditch	6.84	13.7	50
05VN007	sediment	Pho Loc River	6.46	11.9	54
05VN029	sediment	ditch	5.14	10.5	49
05VN016	sediment	Lake WTLD 2 (Xuan Ha Lake)	3.23	32.9	10
05VN013	sediment	Thac Gian Lake	2.28	33.6	7
05VN026	sediment	An Don ditch	1.64	20.2	8
05VN011	sediment	Lake 29.3 (new park)	1.61	8.69	19
05VN011 (Duplicate)	sediment	Lake 29.3 (new park)	1.46	8.47	17
05VN010	sediment	Lake 29.3 (new park)	0.415	2.34	18
05VN028	sediment	An Don pond	0.262	1.42	18
05VN008	sediment	Pho Loc River	0.175	0.449	39
05VN027	sediment	An Don ditch	0.07	0.44	16
05VN027 (Duplicate)	sediment	An Don ditch	0.07	0.42	17

Figure 3.1 Location of soil/sediment sample collection sites, and 2,3,7,8-TCDD data (pg/g, dry weight), Total TEQ, and percent TCDD of Total TEQ, *Da Nang*, Viet Nam, 2005.



The sampling team was not permitted to collect soils on the actual base in areas thought to be former Ranch Hand sites. As a result, sampling sites were selected that were thought to provide reasonable coverage of areas downstream of the main suspected hot spot areas. Sites were also selected that may have been subject to perimeter ground spraying during the conflict.

The highest concentration of TCDD was recorded at Site 18 (i.e., 05VN018 in Tables 3.3 and 3.4; for purposes of discussion in this report, the prefix of “05VN” will be dropped when referring to sampling sites); a level of 227 pg/g TCDD and a TEQ of 269 pg/g was recorded. For this sample, 84% of the TEQ value was due to the toxicity contribution of TCDD, the dioxin present in Agent Orange (Figure 3.1). Site 18 was situated in a lowland area prone to flooding and used for cultivation of edible herbs. Therefore, there is high potential for the local population to come in contact with these concentrations of dioxin and perhaps result in human contamination.

Nestrick *et. al.* (1986) reported that in the United States, the 2,3,7,8-TCDD level in urban soils is typically <10 pg/g. These concentrations are thought to be the result of incineration practices of municipal and industrial origin. If the concentration of 2,3,7,8-TCDD exceeds 10 pg/g, the origin is highly suspect; in the case of Viet Nam, Agent Orange would be the principal target compound responsible for creating such high concentrations.

In Figure 3.1, sampling sites that exceed 10 pg/g TCDD are highlighted with a thicker perimeter line around the site number. The majority of sites are <10 pg/g, with 7 sites exceeding this measure.

Site 22 had a sediment TCDD level of 130 pg/g and a TEQ of 191 pg/g. The Ranch Hand location at Da Nang is suspected to be located near the northern end of the base. It is believed that the high TCDD level at Site 18 was the result of erosion from the Ranch Hand area. If this was the case, the level at Site 22 (130 pg/g) was probably related to perimeter ground spraying, as there was probably little likelihood of sediment movement from northern portions of the base towards Site 22.

In terms of soil guidelines, elevated dioxin at Site 18 would precipitate a response from regulators in Germany (agricultural/playground soils); Japan (research required); British Columbia (Canada; agricultural soils); United States Environmental Protection Agency, Regions 3, 6, and 9; United States ATSDR (evaluation of the site); Canada (federal; agricultural soils); Sweden (residential soils); the Netherlands (agricultural soil); and Finland (protection of human receptors) (Table 3.1).

For Site 22 sediments, all dioxin guideline categories in Table 3.2 are exceeded, including those which are proposed for protection of human health. The most stringent guideline is that from the Wisconsin Dept. of Natural Resources (1 pg/g TEQ) for protection of human receptors. Using this guideline, 16 out of the 21 sites at Da Nang are exceeded.

Anecdotal information from Vietnamese scientists indicate that on the Da Nang Ranch Hand site, soil dioxin has been determined to be in the order of hundreds of thousands of pg/g dry weight. The 10-80/Hatfield team, as noted, was not able to sample directly on the suspected hot spot area. Given that the US EPA and Vietnamese authorities are cooperating on a pilot study at Da Nang addressing dioxin contamination, this area may be considered a “hot spot”. The 10-80/Hatfield sampling design was not able to identify soil/sediment samples that were higher in TCDD concentrations than 227 pg/g; however, the area is suspected to be highly contaminated, and probably has select areas of very high dioxin contamination.

### **3.4.2 Pleiku**

The highest soil TCDD level at Pleiku was recorded at Site 34 (53.4 pg/g; Tables 3.5 and 3.6), and situated at the eastern end of the runway (Figure 3.2). The top seven soil/sediment samples all had relatively high percentages of TCDD to TEQ (Figure 3.2); this is indicative of Agent Orange use in the region, probably through ground spraying.

Site 36 had a high TEQ, due in part to other congeners besides 2,3,7,8-TCDD, which is likely related to historical burning in the immediate area. Note the low percent TCDD of TEQ at Site 36 (2 pg/g; Table 3.6; Figure 3.2).

Three samples exceeded 10 pg/g TCDD (Sites 34, 37, and 42). Data from all other sites were 5.85 pg/g TCDD and lower.

In terms of international guidelines, many of the soil levels have been exceeded, for example, at Sites 34, 36, 37 and 42 (Tables 3.6 and 3.1), with respect to allowable concentrations in agricultural soils, and some residential criteria.

Although Pleiku was a Ranch Hand site, significantly elevated dioxin concentrations were not recorded. Values determined from this study were probably the result of ground spray applications of herbicide rather, than due to storage or spillage. Therefore, based on our results, Pleiku does not appear to be a significant hot spot. Drainage patterns/routes were sampled, with low concentrations found in all cases.

### **3.4.3 Phu Cat**

Tables 3.7 and 3.8 summarize dioxin/furan data for the Phu Cat area. Three soil sites (Sites 8, 48, and 50) exhibited elevated TCDD, with TEQs of 201 pg/g, 169 pg/g and 45.2 pg/g, respectively. Relatively high percent TCDD of TEQ occurred at Sites 8, 48, and 50 (97%, 97%, and 96%, respectively). The top five sites all had relatively high percent TCDD of TEQ (Figure 3.3).

Other dioxin congeners and the furans were low and were not significant contributors to overall toxicity.



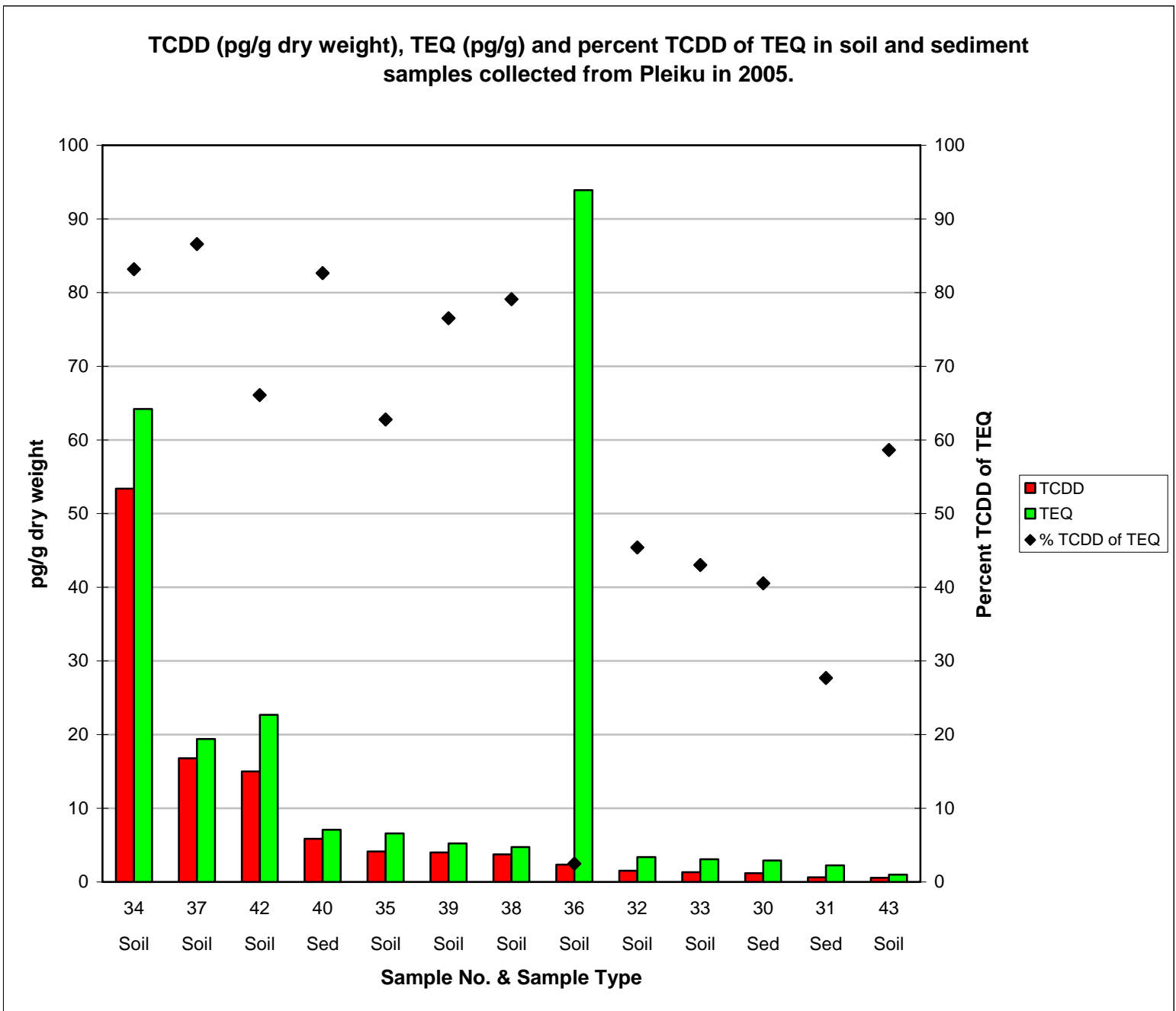
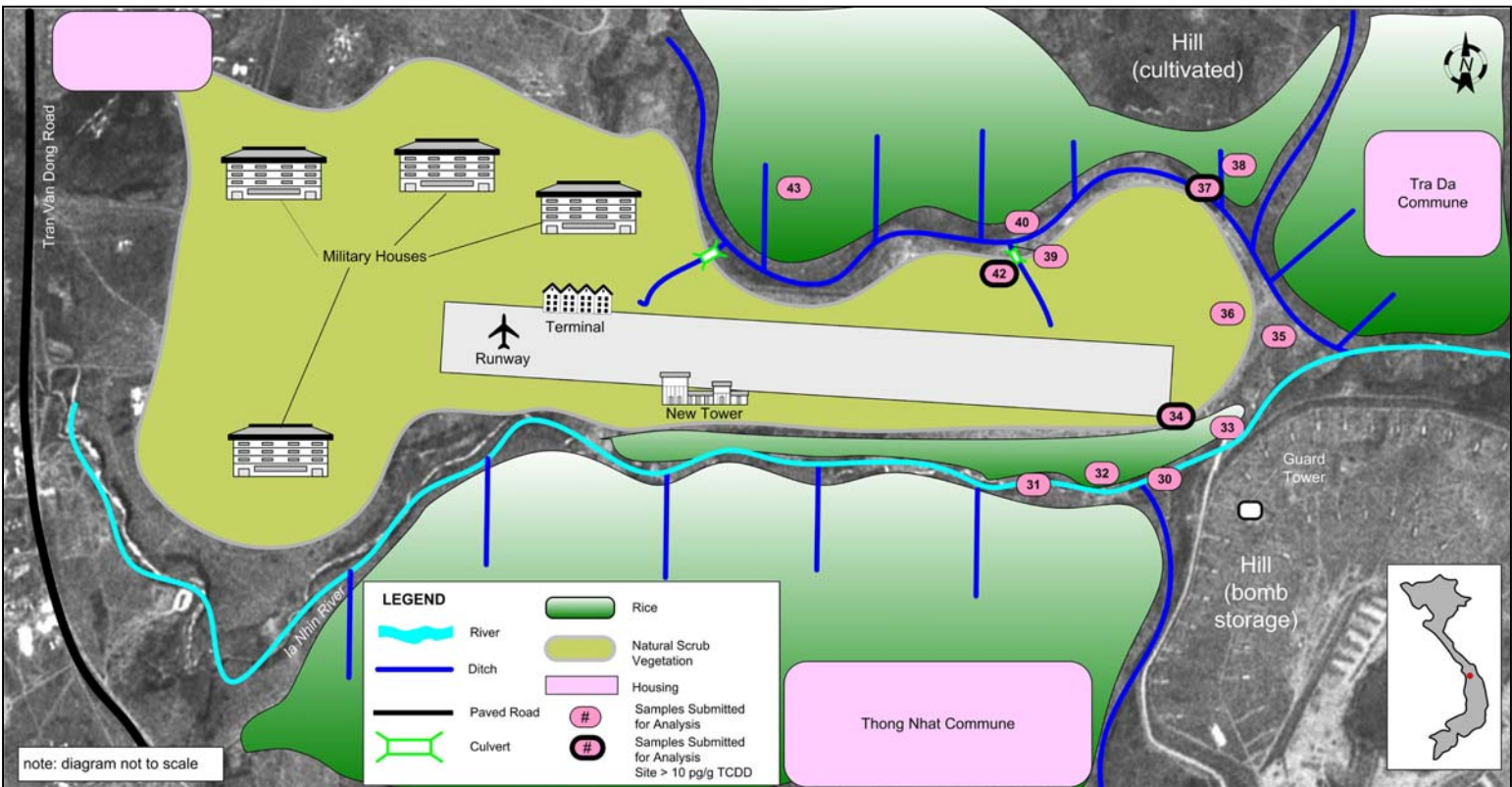
**Table 3.5 Concentrations of polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) in soil and sediment (pg/g [ppt] dry weight), Pleiku, Viet Nam, 2005.**

Sample ID	Sample Type	PCDD (pg/g dry weight)						PCDF (pg/g dry weight)						Total TEQ	TCDD as % of TEQ
		2,3,7,8-TCDD	Total T4CDD	Total P5CDD	Total H6CDD	Total H7CDD	Total O8CDD	2,3,7,8-TCDF	Total T4CDF	Total P5CDF	Total H6CDF	Total H7CDF	Total O8CDF		
05VN-034	Soil	53.4	61.5	21.4	87.4	526	1910	2.67	29	39.5	71.1	122	81.3	64.2	83
05VN-037	Soil	16.8	19.3	6.82	22.1	65.4	238	0.483	8.63	4.71	8.71	13.1	10.2	19.4	87
05VN-042	Soil	15	17.5	10.3	60.6	380	1530	0.87	10.6	13.6	47.9	111	77.2	22.7	66
05VN-040	Sediment	5.85	6.84	2.13	8.68	43.6	182	0.284	4.07	3.69	6.36	9	6.16	7.08	83
05VN-035	Soil	4.13	6.28	4.74	21	96.8	430	0.341	6.24	6.13	12.6	18.7	14.5	6.58	63
05VN-039	Soil	4.01	5.15	2.32	9.51	40.4	161	0.246	3.1	3.09	5.57	8.49	6.32	5.25	76
05VN-038	Soil	3.75	4.76	1.98	8.47	24.5	111	0.161	2.51	1.94	3.43	4.07	2.92	4.74	79
05VN-036	Soil	2.34	7.28	76.6	758	5020	21000	0.948	14.8	154	836	1720	1040	93.9	2
05VN-032	Soil	1.53	4.13	4.18	13.6	60.2	252	0.379	9.47	6.81	9.59	12.8	8.85	3.37	45
05VN-033	Soil	1.33	3.34	3.5	12.2	57	241	0.315	6.95	5.77	9.38	14	10.8	3.09	43
05VN-030	Sediment	1.18	3.67	2.5	13.3	65.6	278	0.316	8.92	7.51	13.2	27.3	28.2	2.91	41
05VN-031	Sediment	0.623	2.97	2.92	11.4	51.9	228	0.394	8.7	6.58	10.1	19.8	20.3	2.25	28
05VN-043	Soil	0.575	0.884	0.671	2.69	5.56	20.8	0.049	0.839	0.607	0.987	0.923	0.753	0.994	58

**Table 3.6      2,3,7,8-TCDD (pg/g dry weight), TEQ (pg/g), and percent TCDD of the TEQ value for soil and sediment samples from Pleiku, Viet Nam, 2005.**

Sample ID	Sample Type	Location	TCDD	TEQ	% TCDD of TEQ
05VN034	soil	natural vegetation	53.4	64.2	83
05VN037	soil	natural vegetation	16.8	19.4	87
05VN042	soil	natural vegetation	15	22.7	66
05VN040	sediment	ditch	5.85	7.08	83
05VN035	soil	rice field	4.13	6.58	63
05VN039	soil	rice field	4.01	5.24	77
05VN038	soil	rice field	3.75	4.74	79
05VN036	soil	natural vegetation	2.34	93.9	2
05VN032	soil	rice field	1.53	3.37	45
05VN033	soil	rice field	1.33	3.09	43
05VN030	sediment	Ia Nhin River	1.18	2.91	41
05VN031	sediment	Ia Nhin River	0.623	2.25	28
05VN043	soil	rice field	0.575	0.981	59

Figure 3.2 Location of soil/sediment sample collection sites, and 2,3,7,8-TCDD data (pg/g, dry weight), Total TEQ, and percent TCDD of Total TEQ, *Pleiku*, Viet Nam, 2005.





**Table 3.7 Concentrations of polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) in soil and sediment (pg/g [ppt] dry weight), Phu Cat, Viet Nam, 2005.**

Sample ID	Sample Type	PCDD (pg/g dry weight)						PCDF (pg/g dry weight)						Total TEQ	TCDD as % of TEQ
		2,3,7,8-TCDD	Total T4CDD	Total P5CDD	Total H6CDD	Total H7CDD	Total O8CDD	2,3,7,8-TCDF	Total T4CDF	Total P5CDF	Total H6CDF	Total H7CDF	Total O8CDF		
04VN-008*	Sediment	194	210	29.7	42	78.2	312	11.6	60.5	85.5	28.3	16.5	12.4	201	97
05VN-048	Soil	164	173	18.9	22.1	36.5	165	14.8	44.4	52.1	10.9	7.07	4.92	169	97
05VN-050	Soil	43.2	48.6	9.3	16.1	21.5	71.9	2.28	25.3	25	7.68	2.72	1.35	45.2	96
05VN-052	Soil	22.4	25.6	8.03	14.2	21	123	1.29	10.6	7.52	4.89	2.42	1.47	23.9	94
05VN-061	Soil	4.47	5.93	3.75	7.37	7.69	29.7	0.464	6.88	2.29	1.33	0.834	0.565	5.14	87
05VN-045	Sediment	3.25	4.11	2.39	19.7	111	390	0.42	3.47	5.15	13.3	20.9	13.9	5.23	62
05VN-057	Sediment	2.52	9.23	7.81	32.2	146	524	3.06	28	40.5	29.6	22.3	11.7	7.19	35
05VN-055	Sediment	2	8.65	14.7	81.4	425	1660	2.81	30.3	50.5	54.5	42.8	20.7	9.91	20
05VN-051	Soil	0.9	1.3	0.54	3.55	19.2	370	0.18	2.35	2.38	2.23	1.81	0.81	1.36	66
05VN-053	Sediment	0.78	1.16	0.59	4.71	11.3	41.1	1.34	12.4	31.9	20.4	5.29	1.91	2.48	31
05VN-054	Soil	0.75	3.09	4.23	23.3	102	372	0.93	7.23	8.36	10.6	7.97	4.45	2.61	29
05VN-060	Soil	0.748	1.99	2.61	11.8	55.3	195	0.586	4.99	8.92	9.74	6.86	3.48	2.03	37
05VN-047	Sediment	0.603	1.02	0.998	5.64	25.5	82.9	0.233	1.43	1.68	3.47	4.48	3.36	1.13	53
05VN-058	Soil	0.554	1.25	0.943	4.19	15.1	42.1	0.1	2.89	1.57	2.13	1.4	0.655	1.1	50
05VN-059	Soil	0.41	1.34	1.45	6.34	29.7	107	0.29	2.96	4.9	5.45	4.29	2.73	1.14	36
05VN-062	Sediment	0.34	1.14	1.85	5.84	14.2	46.9	0.30	4.54	3.98	3.36	2.4	1.98	1.21	28
05VN-056	Sediment	0.3	0.3	0.24	4.52	23.9	102	0.21	2.24	3.98	4.18	2.93	1.48	0.79	38
05VN-049	Soil	0.191	0.28	0.055	2.06	5.91	26.1	0.084	0.281	0.4	0.961	0.621	0.253	0.485	39

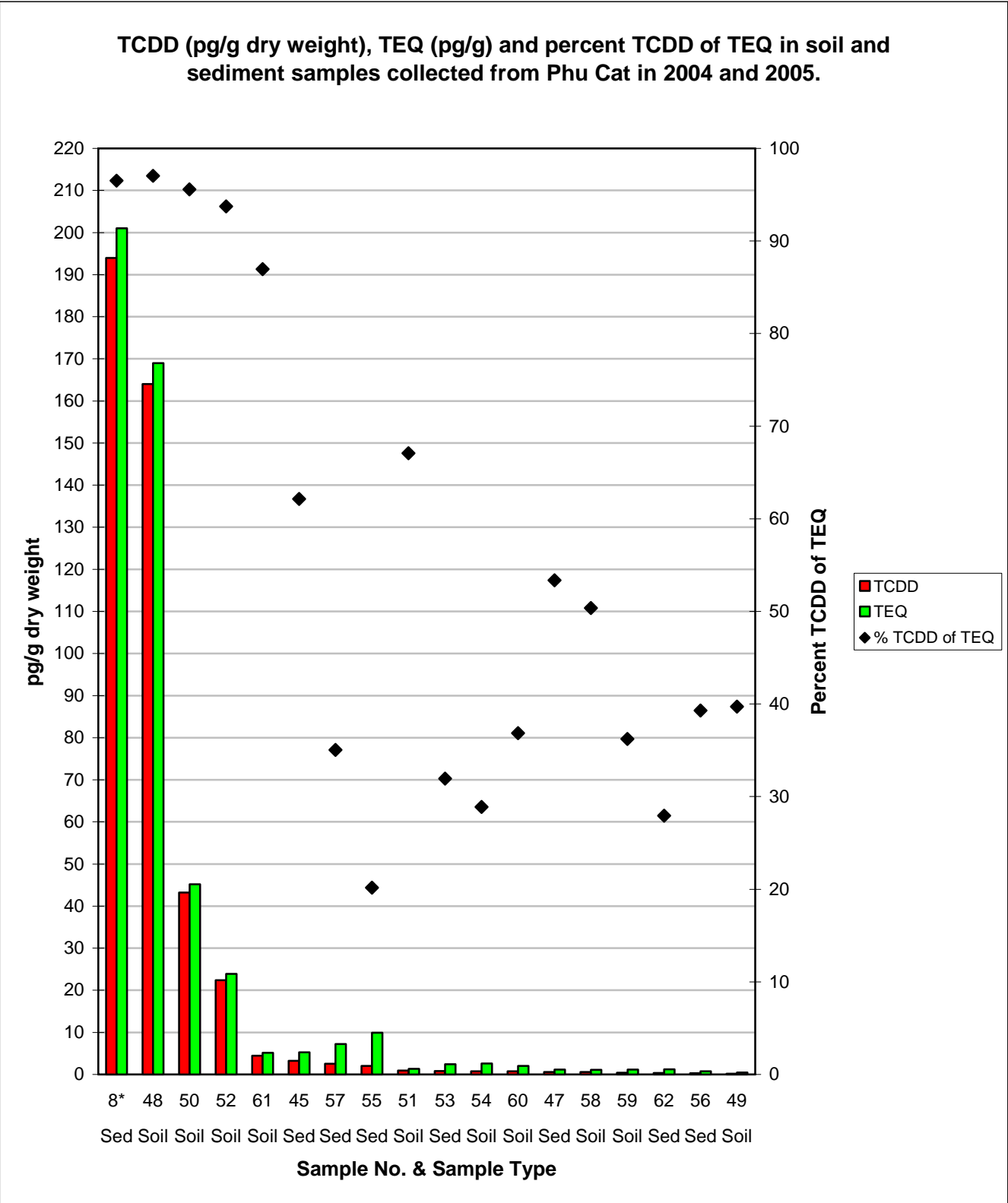
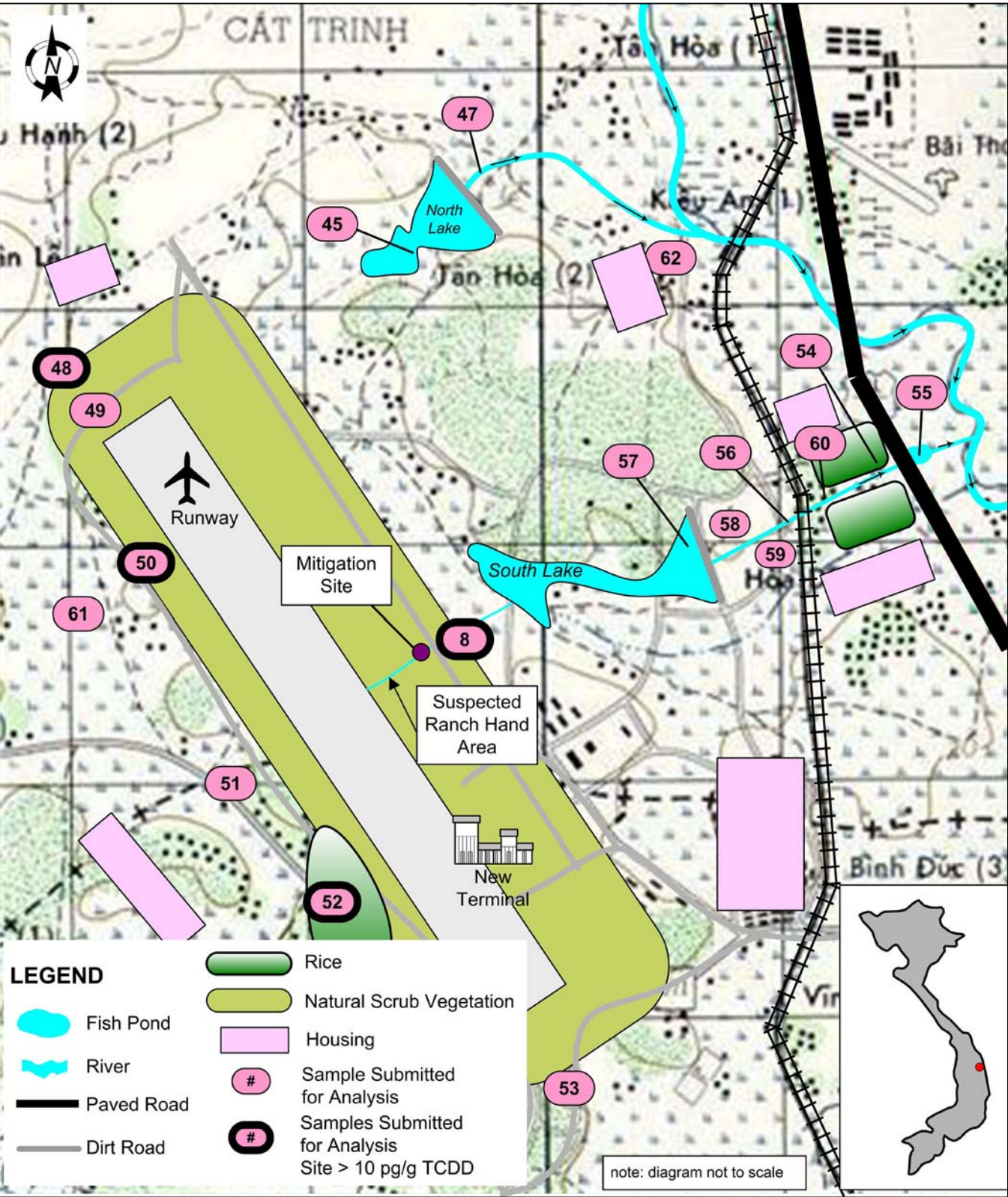
\* Collected in 2004.

**Table 3.8 2,3,7,8-TCDD (pg/g dry weight), TEQ (pg/g), and percent TCDD of the TEQ value for soil and sediment samples from Phu Cat, Viet Nam, 2004 and 2005.**

Sample ID	Sample Type	Location	TCDD	TEQ	% TCDD of TEQ
04VN008*	sediment	stream sediment	194	201	97
05VN048	soil	natural vegetation	164	169	97
05VN050	soil	natural vegetation	43.2	45.2	96
05VN052	soil	rice field	22.4	23.9	94
05VN061	soil	rice field	4.47	5.14	87
05VN045	sediment	North Lake B	3.25	5.23	62
05VN057	sediment	South Lake	2.52	7.19	35
05VN055	sediment	pond	2	9.91	20
05VN051	soil	cultivated land	0.899	1.34	67
05VN053	sediment	ditch	0.783	2.45	32
05VN054	soil	rice field	0.754	2.61	29
05VN060	soil	small river flood plain	0.748	2.03	37
05VN047	sediment	ditch	0.603	1.13	53
05VN058	soil	natural vegetation	0.554	1.1	50
05VN059	soil	grazing area	0.413	1.14	36
05VN062	sediment	water spring	0.338	1.21	28
05VN056	sediment	small river	0.301	0.766	39
05VN049	soil	natural vegetation	0.191	0.485	39

\* Collected in 2004.

Figure 3.3 Location of soil/sediment sample collection sites, and 2,3,7,8-TCDD data (pg/g, dry weight), Total TEQ, and percent TCDD of Total TEQ, Phu Cat, Viet Nam, 2004 and 2005.



\* Collected in 2004

The highest sediment TCDD level was recorded at Site 8 (194 pg/g). This location was downstream of a dioxin mitigation site established by Vietnamese authorities. This site was also downstream of the suspected Ranch Hand operational area on the base. Consequently, Site 8 sediments represent dioxins resulting from downstream flow of erosional components from the Ranch Hand zone near the runway (Figure 3.3). Runoff from this zone ultimately flows into South Lake, which is used for irrigation purposes. It is highly probable that villagers using the lake could be exposed to dioxin through exposure during work in the paddies, consumption of fish, and perhaps other food items (*cf.* Appendix A3.3 photos). Sampling of foods in this region was not undertaken in the current study.

Soil Site 48 exhibited a TCDD value of 164 pg/g. Given this area is well removed from the suspected Ranch Hand site, it is believed the high TCDD value is related to historical perimeter ground spraying of Agent Orange.

Soil Sites 50 and 52 also had slightly elevated TCDD concentrations (43.2 and 22.4 pg/g, respectively). There is a high probability that if the 10-80/Hatfield team was permitted to sample directly on the Ranch Hand site, higher TCDD levels probably would have been recorded.

As in the Da Nang scenario, many of the jurisdictional guidelines for soil presented in Table 3.1 are exceeded at Phu Cat, which would prompt action in several countries. Similarly, proposed sediment guidelines in Table 3.2 are exceeded, which would also promote some form of remediation action in these jurisdictions.

#### **3.4.4 Nha Trang**

During the preparatory phases of this program, the 10-80/Hatfield team obtained information on the location of the Ranch Hand site at Nha Trang. This information was obtained from military archives in Washington, D.C.

A total of four soil samples and one sediment sample was collected at Nha Trang (Tables 3.9 and 3.10). Site 63 (soil) was situated in the vicinity of the suspected Ranch Hand location. This site yielded the highest TCDD value, 48.7 pg/g with a percent TCDD of TEQ of 37%; the low percentage TCDD in the TEQ was due to the relatively high levels of other dioxin congeners (Table 3.9 and Figure 3.4).

Octa-dioxin concentrations were relatively high at most sites, indicative of historical burning in the region.

Our data suggest that the Nha Trang area should not be considered a significant hot spot; however, in certain jurisdictions dioxin levels at Site 63 may trigger some form of regulatory response (Table 3.1).

**Table 3.9 Concentrations of polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) in soil and sediment (pg/g [ppt] dry weight), Nha Trang, Viet Nam, 2005.**

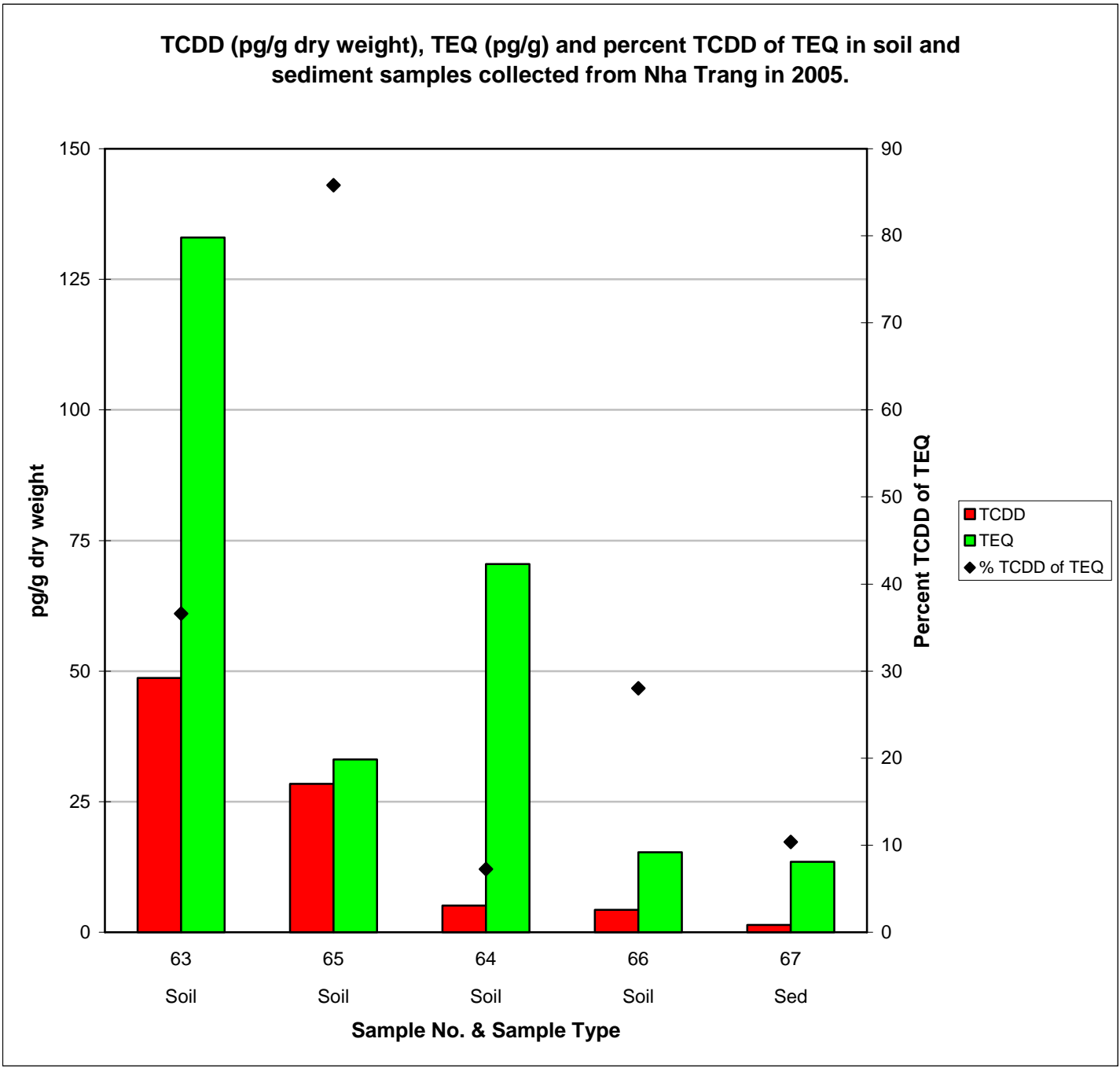
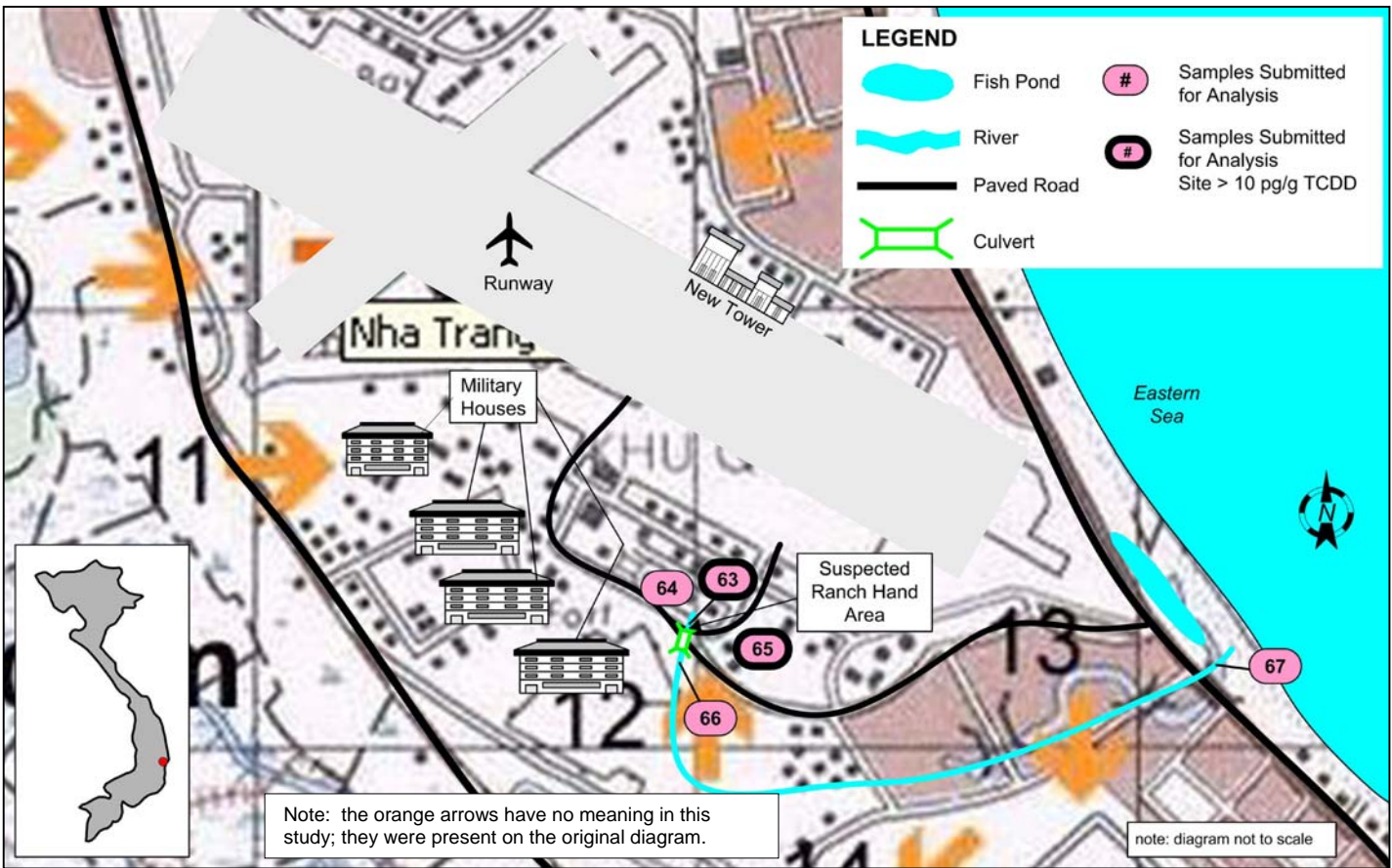
Sample ID	Sample Type	PCDD (pg/g dry weight)						PCDF (pg/g dry weight)						Total TEQ	TCDD as % of TEQ
		2,3,7,8-TCDD	Total T4CDD	Total P5CDD	Total H6CDD	Total H7CDD	Total O8CDD	2,3,7,8-TCDF	Total T4CDF	Total P5CDF	Total H6CDF	Total H7CDF	Total O8CDF		
05VN-063	Soil	48.7	90.4	171	814	3600	12200	12.4	143	249	423	573	285	133	37
05VN-065	Soil	28.4	30.7	7.84	48.9	277	984	0.591	5.17	14	26.4	32	17.9	33.1	86
05VN-064	Soil	5.11	23.5	91.2	524	3930	18200	6.53	64.7	143	463	1090	688	70.5	7
05VN-066	Soil	4.29	6.02	9.47	89.6	702	3640	1.18	10.8	34.5	76.9	107	63.1	15.3	28
05VN-067	Sediment	1.4	9.25	12.2	114	1300	5060	0.97	11.9	25.3	58.9	71.1	31.5	13.5	10

**Table 3.10 2,3,7,8-TCDD (pg/g dry weight), TEQ (pg/g), and percent TCDD of the TEQ value for soil and sediment samples from Nha Trang, Viet Nam, 2005.**

Sample ID	Sample Type	Location	TCDD	TEQ	% TCDD of TEQ
05VN063	soil	on base	48.7	133	37
05VN065	soil	on base	28.4	33.1	86
05VN064	soil	on base	5.11	70.5	7
05VN066	soil	on base	4.29	15.3	28
05VN067	sediment	ditch	1.4	13.5	10



Figure 3.4 Location of soil/sediment sample collection sites, and 2,3,7,8-TCDD data (pg/g, dry weight), Total TEQ, and percent TCDD of Total TEQ, *Nha Trang*, Viet Nam, 2005.



### 3.4.5 Bien Hoa

Tables 3.11 and 3.12 provide a comprehensive overview of dioxin/furan levels in soils and sediments collected at 23 sampling sites.

The highest soil TCDD was recorded at Site 89, 392 pg/g, with a resulting TEQ of 425 pg/g (92% TCDD of TEQ; Table 3.11). The highest sediment dioxin value was recorded at Site 78, (797 pg/g TCDD and 833 pg/g TEQ). Over 96% of the TEQ was TCDD, clearly indicating Agent Orange as the source. Sites 89 and 78 are located in two geographically separate regions near the Bien Hoa base suggesting extensive contamination in different areas. The origin of the contamination at these aforementioned sites may be the herbicide storage area.

Sites 85, 86, 87, 88, and 89 all exhibited dioxin in levels >40 pg/g TCDD (and greater than 80% TCDD of TEQ).

A number of sites situated near South (S) Base Lake and Bien Hung Lake (*cf.* Appendix A3.5 photos) also exhibited elevated dioxin levels (Figure 3.5). The TCDD level in sediments from this area ranged from 31.1 pg/g TCDD (86% TCDD of TEQ) to 797 pg/g TCDD (96% TCDD of TEQ; 833 pg/g TEQ). Schecter *et. al.* (2001) reported sediment dioxin in Bien Hung Lake 1 and Bien Hung Lake 2. There is no information in their publication as to the location of these lakes or of the samples collected. It is assumed that our South Base Lake may be either Bien Hung Lake 1 or 2. Nevertheless, Schecter *et. al.* (2001) reported 177 pg/g TCDD as the highest value from both lakes.

In the present study, 797 pg/g TCDD (Site 78) was the highest value recorded. The other sediment value from South Base Lake was 224 pg/g TCDD (Table 3.11).

The highest soil TCDD in the South Base Lake area was recorded at Site 80, 284 pg/g TCDD (97% TCDD of 294 pg/g TEQ). Schecter *et. al.* (2001) reported a soil TCDD level from the Bien Hoa area of greater than 1 million pg/g. However, the exact origin of the sample is not known by the senior author (*pers. comm.*).

Two distinct TCDD “groupings” (i.e., east end of the runway and South Base/Bien Hung Lakes) have very high percent TCDD of TEQ values (Table 3.12 and Figure 3.5). These data indicate high Agent Orange involvement in the soils and sediment contamination near the Bien Hoa base.

It is reasonable to conclude that with the maximum TEQ of 833 pg/g in sediments and a 424 pg/g TEQ in soil, there likely exists higher values in the region (e.g., Schecter’s soil sample of unknown origin). This being the case, virtually all of the soil and sediment guidelines in Tables 3.1 and 3.2 would be exceeded, thus promoting some form of regulatory action in these jurisdictions.

The Bien Hoa base and vicinity can be classified as a significant dioxin hot spot.

**Table 3.11 Concentrations of polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) in soil and sediment (pg/g [ppt] dry weight), Bien Hoa, Viet Nam, 2004 and 2005.**

Sample ID	Sample Type	PCDD (pg/g dry weight)						PCDF (pg/g dry weight)						Total TEQ	TCDD as % of TEQ
		2,3,7,8-TCDD	Total T4CDD	Total P5CDD	Total H6CDD	Total H7CDD	Total O8CDD	2,3,7,8-TCDF	Total T4CDF	Total P5CDF	Total H6CDF	Total H7CDF	Total O8CDF		
05VN-078	Sediment	797	866	111	174	467	1670	52.3	202	224	81.8	89.3	73.2	833	96
05VN-089	Soil	392	451	84.8	272	1520	5350	15	141	195	194	292	168	424	92
05VN-080	Soil	284	308	34.7	48.6	82.8	244	9.5	67.3	65.9	18.3	14.6	11.7	294	97
05VN-074	Soil	279	311	26.5	60.1	205	620	26.5	111	89.8	28.3	23.2	16	287	97
05VN-087	Soil	257	290	32	36.1	69.3	201	18.2	84.3	83.8	15.5	9.64	6.4	267	96
05VN-079	Sediment	224	247	30.7	47.2	134	487	15	58.5	65.1	26.2	34.2	34.5	234	96
05VN-095	Soil	208	233	43.5	107	439	1840	26.6	94.7	90.7	64.6	83.8	58.4	224	93
04VN-014*	Sediment	96.7	119	21.5	65.8	411	1990	17.1	57.8	37.8	35.8	90.7	103	106	91
05VN-102	Sediment	96	176	98.4	268	1110	4560	13.7	165	148	173	260	200	131	73
05VN-088	Sediment	82.8	102	36.7	145	888	3300	6.98	50	86.5	119	172	106	101	82
05VN-081	Sediment	76.9	84.6	11.1	16.6	43.5	178	4.51	26	25.6	9.21	8.19	6.36	80.3	96
05VN-085	Sediment	41.5	55.5	16.8	56.3	327	1300	2.89	26.2	34.7	48.8	64.6	39.8	48.3	86
05VN-086	Sediment	40.6	50.7	19	105	559	1650	1.94	20.8	29.6	45.3	69.7	53.4	48.7	83
05VN-103	Sediment	31.1	149	22.2	61.1	154	806	5.22	86.8	17.5	11.4	8.51	6.06	36	86
05VN-077	Soil	27.1	45	27.1	60.4	159	634	8.93	92.4	97.9	111	90.4	41.9	39.4	69
05VN-073	Soil	18.8	30	16.4	31.6	104	676	3.29	17.8	12	8.81	9.48	7.07	22.6	83
04VN-013*	Soil	12.2	17.4	7.81	17	58.7	604	1.63	17.1	6.99	4.3	3.45	1.92	14.3	85
05VN-094	Sediment	5.22	14.4	9.52	38.3	146	717	0.64	8.99	8.61	14.6	18.4	15.7	8.24	63
05VN-097	Sediment	3.73	27.5	29.7	83.1	404	2470	2.12	46	42.1	81.1	217	296	14.8	25
05VN-101 (Duplicate)	Sediment	2.73	13.4	16	61.1	288	1680	0.93	17.3	21.4	49.3	176	214	8.81	31
05VN-101	Sediment	2.72	14.1	15.5	68.5	310	1770	1.05	19.7	21.7	49.9	179	223	9.03	30
05VN-098	Sediment	0.97	14.2	17.9	88.9	288	1010	0.18	3.99	3.58	7.32	20.5	24.4	3.26	30
05VN-096	Soil	0.596	8.55	6.59	23.1	92.1	627	0.387	38.5	5.67	6.6	5.37	4.43	2.76	22
04VN-011*	Sediment	0.3	0.86	1.36	6.11	26.6	102	0.18	1.98	2.25	3.29	4.57	3.13	1.2	25

\* Collected in 2004.

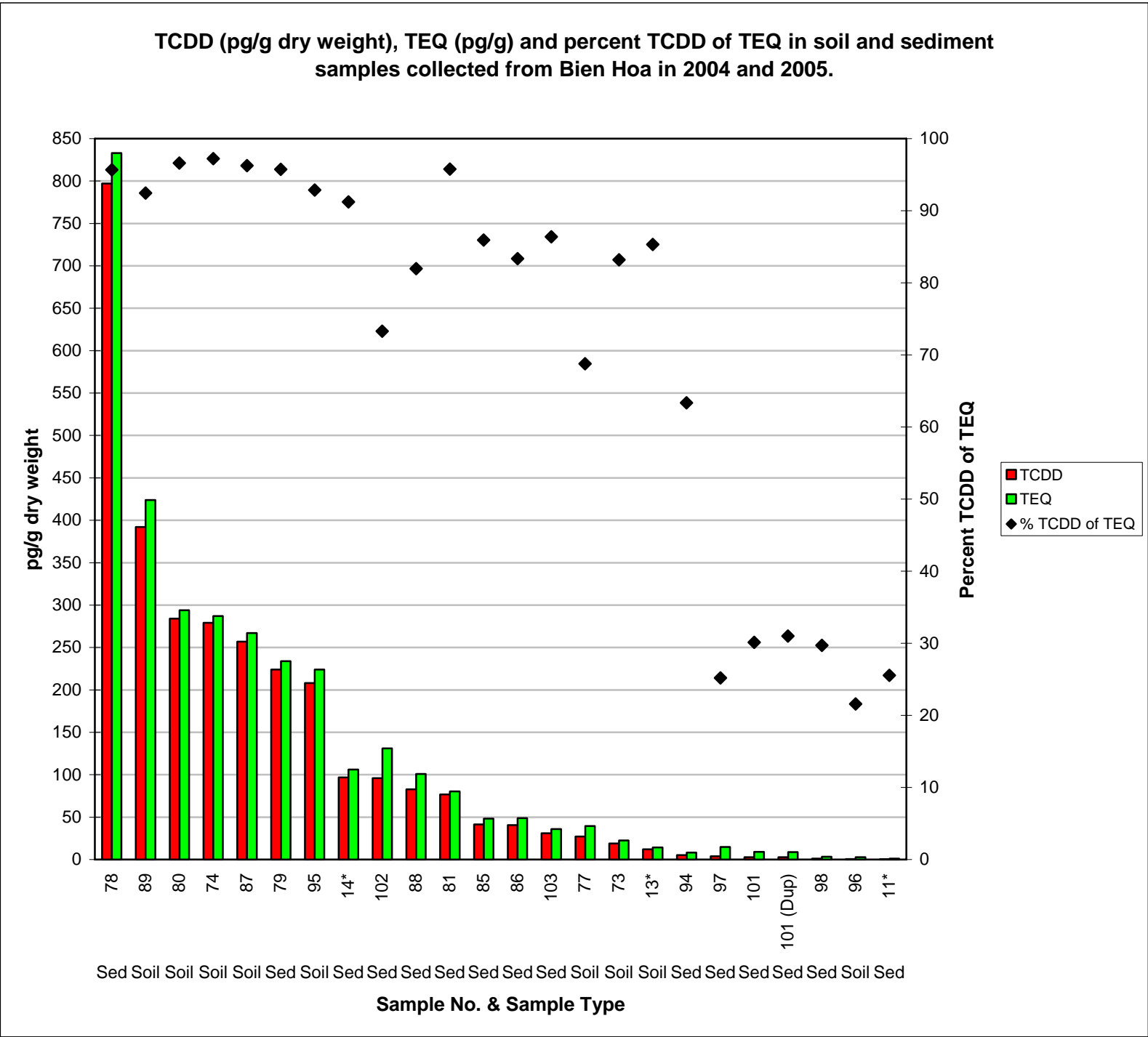
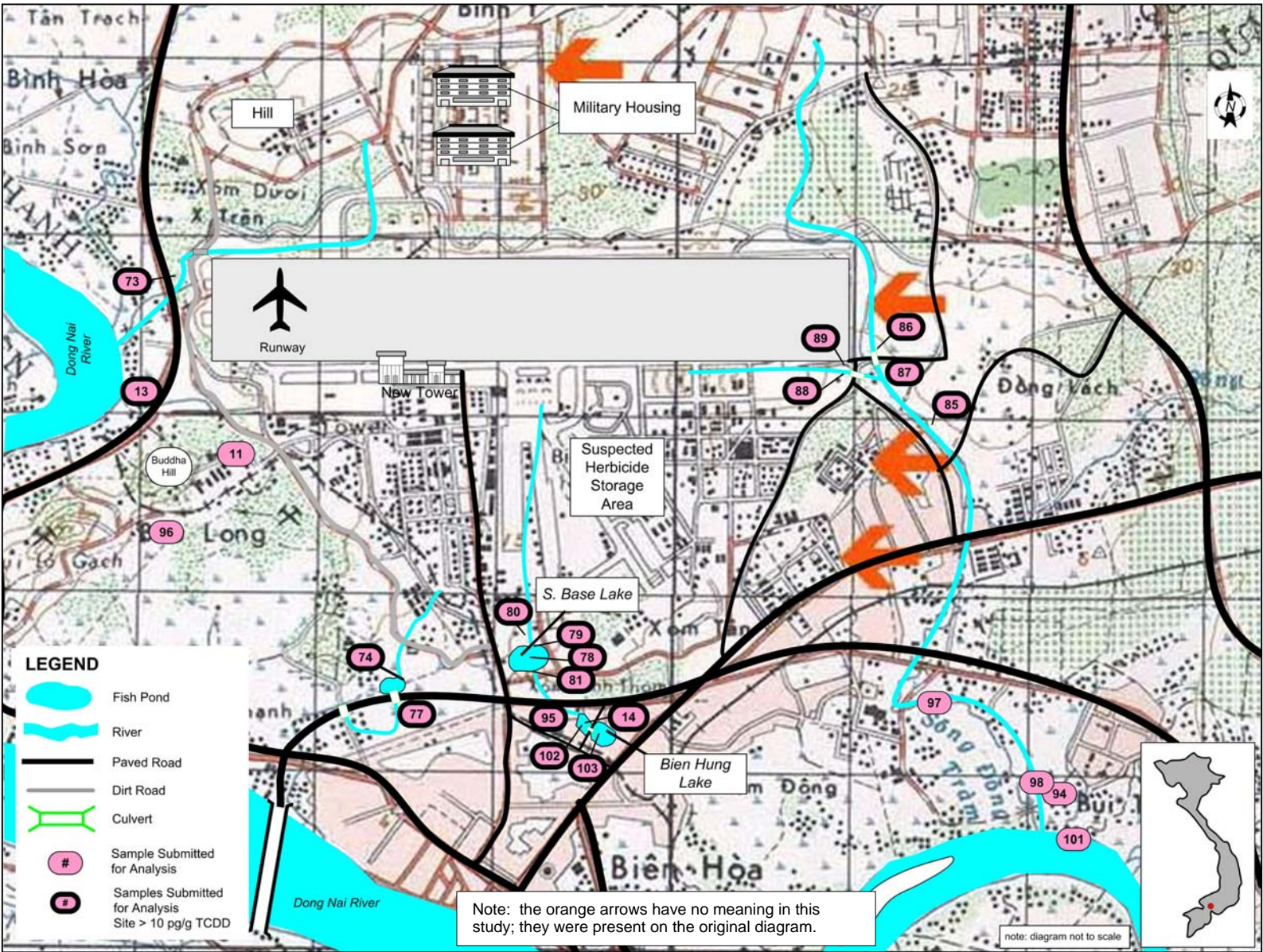


**Table 3.12 2,3,7,8-TCDD (pg/g dry weight), TEQ (pg/g), and percent TCDD of the TEQ value for soil and sediment samples from Bien Hoa, Viet Nam, 2004 and 2005.**

Sample ID	Sample Type	Location	TCDD	TEQ	% TCDD of TEQ
05VN078	sediment	lake in airbase	797	833	96
05VN089	soil	natural vegetation	392	424	92
05VN080	soil	natural vegetation	284	294	97
05VN074	soil	grazing area/wetland	279	287	97
05VN087	soil	grazing area	257	267	96
05VN079	sediment	lake in airbase	224	234	96
05VN095	soil	garden	208	224	93
04VN014*	sediment	Bien Hung Lake	96.7	106	91
05VN102	sediment	Bien Hung Lake	96	131	73
05VN088	sediment	base stream	82.8	101	82
05VN081	sediment	lake in airbase	76.9	80.3	96
05VN085	sediment	Hoa Bang stream	41.5	48.3	86
05VN086	sediment	Hoa Bang stream	40.6	48.7	83
05VN103	sediment	Bien Hung Lake	31.1	36	86
05VN077	soil	old rice field	27.1	39.4	69
05VN073	soil	old rice field	18.8	22.6	83
04VN013*	soil	farmers field	12.2	14.3	85
05VN094	sediment	fish pond	5.22	8.24	63
05VN097	sediment	Suoi Lon	3.73	14.8	25
05VN101	sediment	Dong Nai River	2.72	9.03	30
05VN101 (Duplicate)	sediment	Dong Nai River	2.73	8.81	31
05VN098	sediment	Suoi Lon	0.969	3.26	30
05VN096	soil	cultivated land	0.596	2.76	22
04VN011*	sediment	marsh SW of base	0.304	1.19	26

\* Collected in 2004.

Figure 3.5 Location of soil/sediment sample collection sites, and 2,3,7,8-TCDD data (pg/g, dry weight), Total TEQ, and percent TCDD of Total TEQ, *Bien Hoa*, Viet Nam, 2004 and 2005.



\* Collected in 2004

### 3.4.6 Can Tho

Tables 3.13 and 3.14 summarize dioxin/furan data for the Can Tho region. The maximum soil TCDD was 68.7 pg/g (70.4 pg/g TEQ). Maximum sediment TCDD was 38.5 pg/g (40.1 pg/g TEQ).

At those sites where H7CDD and O8CDD were highest (Sites 111 and 112) the percent TCDD of TEQ was lower relative to the remaining sites where both these congener types, including furans, were much reduced (Figure 3.6).

It would appear that certain soil/sediment guidelines (Tables 3.1 and 3.2) would be exceeded by some of the Can Tho data (e.g., soil Sites 123, 112 and 111; sediment Sites 104, 108 and 116). On this basis, remedial action would probably ensue in these jurisdictions as human populations near Site 123, for example, could come in contact with the dioxin contaminant.

Generally, it is suspected that the dioxin contaminant at Can Tho primarily relates to ground perimeter spraying of herbicide. Can Tho is therefore not considered a significant dioxin hot spot.

### 3.4.7 Tan Son Nhut

Tables 3.15 and 3.16 summarize dioxin/furan data for Tan Son Nhut. Two soil samples and three sediment samples were collected.

A soil and sediment sample were collected from Charlie Sector which was the area of the base where the Ranch Hand operation was thought to be stationed.

Sediment from Site 128 exhibited the lone elevated value, 157 pg/g TCDD, 341 pg/g TEQ, 46% TCDD of TEQ. The H6CDD, H7CDD and O8CDD congeners at Site 128 undoubtedly contributed to the lowering of TCDD responsibility in overall toxicity.

Sediment at Site 128 exceeds proposed sediment guidelines in numerous jurisdictions (Table 3.2) for protection of human populations, and would promote some form of remedial measure if located in other western countries. However, given that the region in question near Site 128 is principally industrial in nature, and the chances for human contact are relatively low, little response, in terms of remediation, may be expected.

**Table 3.13 Concentrations of polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) in soil and sediment (pg/g [ppt] dry weight), Can Tho, Viet Nam, 2005.**

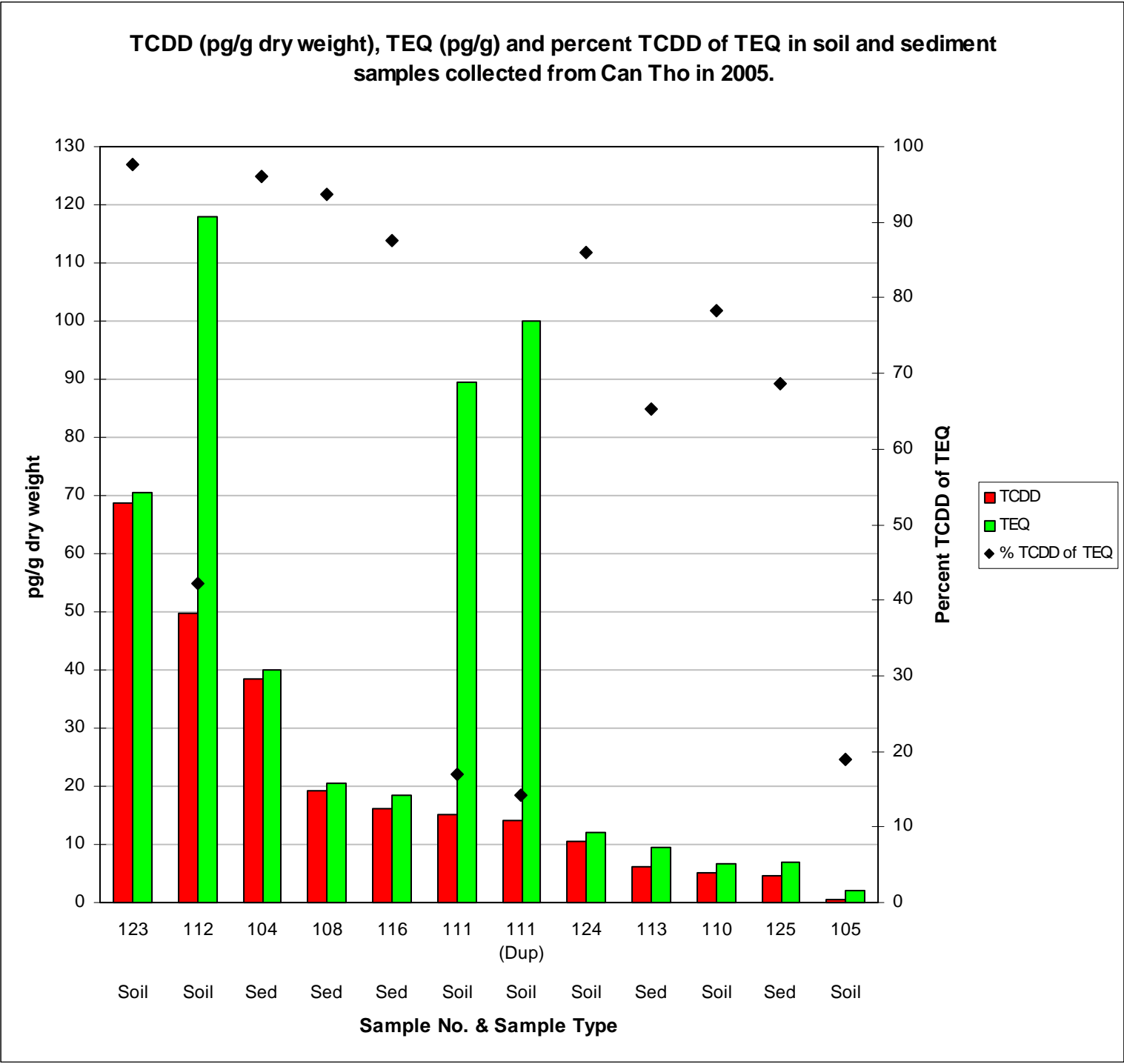
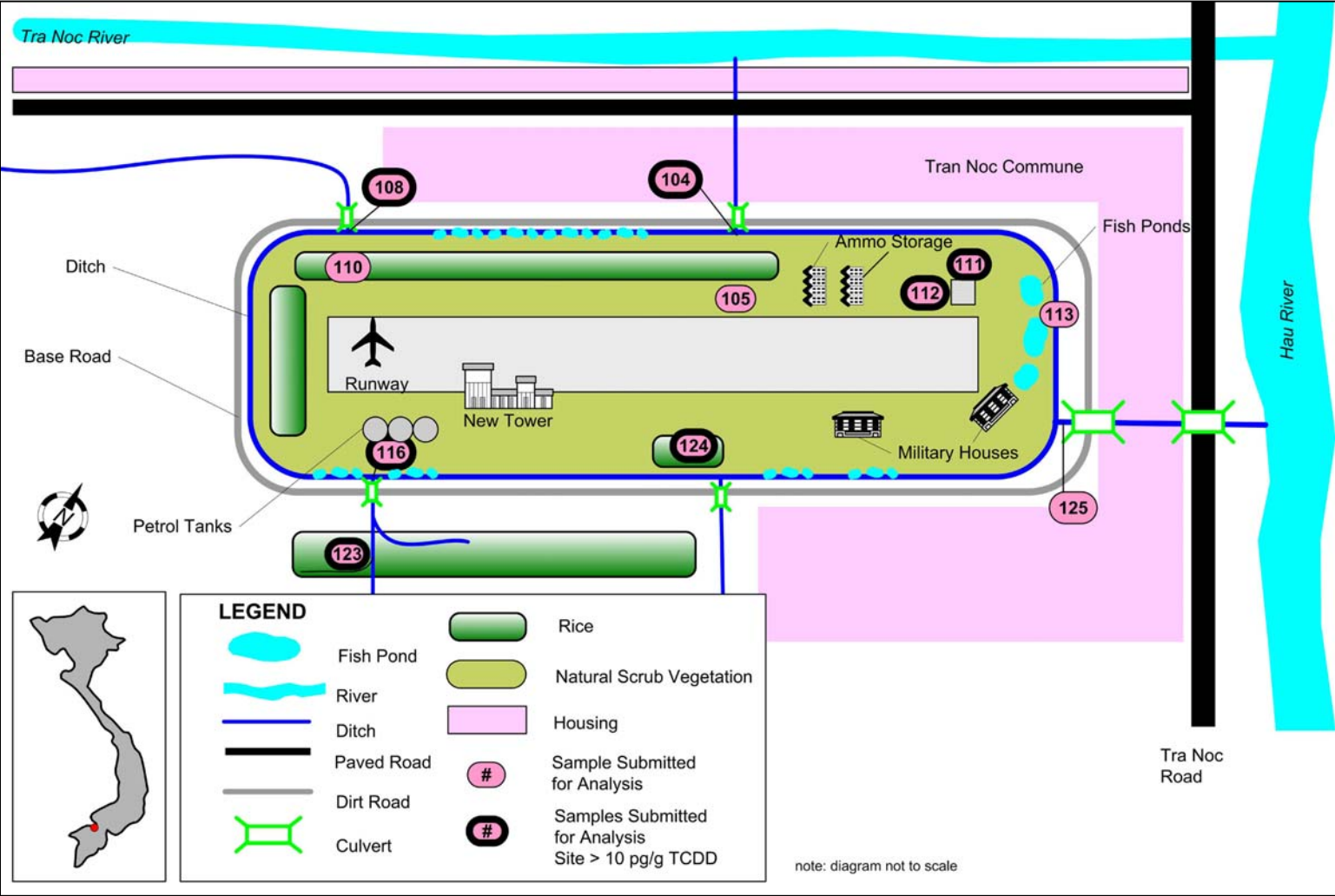
Sample ID	Sample Type	PCDD (pg/g dry weight)						PCDF (pg/g dry weight)						Total TEQ	TCDD as % of TEQ
		2,3,7,8-TCDD	Total T4CDD	Total P5CDD	Total H6CDD	Total H7CDD	Total O8CDD	2,3,7,8-TCDF	Total T4CDF	Total P5CDF	Total H6CDF	Total H7CDF	Total O8CDF		
05VN-123	Soil	68.7	79	8.8	26	61.4	304	6.23	17	4.86	2.94	2.6	1.56	70.4	98
05VN-112	Soil	49.7	65.4	78.1	579	4450	23100	1.67	28.1	120	538	993	620	118	42
05VN-104	Sediment	38.5	44.7	7.1	25.3	87	407	0.856	6.18	5.67	7.37	7.08	5.45	40.1	96
05VN-108	Sediment	19.2	27.3	6.93	25.6	78.2	428	0.752	8.11	4.96	5.85	13.7	16.1	20.5	94
05VN-116	Sediment	16.1	19.4	6.76	28.8	134	675	0.9	6.03	9.95	14.3	17.7	11.3	18.4	88
05VN-111	Soil	15.2	57.4	148	793	5000	20100	5.75	50.5	113	337	568	416	89.4	17
05VN-111 (Duplicate)	Soil	14.2	61.5	177	930	5740	22400	6.25	54.8	123	362	663	483	100	14
05VN-124	Soil	10.4	17	7.99	26.8	83.4	374	1.22	19.3	4.99	5.49	5.1	2.57	12.1	86
05VN-113	Sediment	6.13	9.5	9.72	47.6	207	924	0.6	5.84	9.15	16.5	25.8	20.5	9.4	65
05VN-110	Soil	5.24	11.2	6.56	19.8	59.5	328	0.75	15.8	3.8	5.07	1.9	1.12	6.7	78
05VN-125	Sediment	4.74	6.89	4.73	23.5	130	798	0.27	3.21	5.41	14.6	24.4	15.9	6.9	69
05VN-105	Soil	0.388	1.8	2.36	14	91.3	522	0.157	3.78	4.74	10.9	10.2	4.12	2.04	19

**Table 3.14 2,3,7,8-TCDD (pg/g dry weight), TEQ (pg/g), and percent TCDD of the TEQ value for soil and sediment samples from Can Tho, Viet Nam, 2005.**

Sample ID	Sample Type	Location	TCDD	TEQ	% TCDD of TEQ
05VN123	soil	rice field	68.7	70.4	98
05VN112	soil	natural vegetation	49.7	118	42
05VN104	sediment	ditch	38.5	40.1	96
05VN108	sediment	ditch	19.2	20.5	94
05VN116	sediment	ditch	16.1	18.4	88
05VN111	soil	cultivated land	15.2	89.4	17
05VN111 (Duplicate)	soil	cultivated land	14.2	100	14
05VN124	soil	rice field	10.4	12.1	86
05VN113	sediment	ditch	6.13	9.4	65
05VN110	soil	rice field	5.24	6.7	78
05VN125	sediment	ditch	4.74	6.9	69
05VN105	soil	natural vegetation	0.388	2.04	19



Figure 3.6 Location of soil/sediment sample collection sites, and 2,3,7,8-TCDD data (pg/g, dry weight), Total TEQ, and percent TCDD of Total TEQ, *Can Tho*, Viet Nam, 2005.



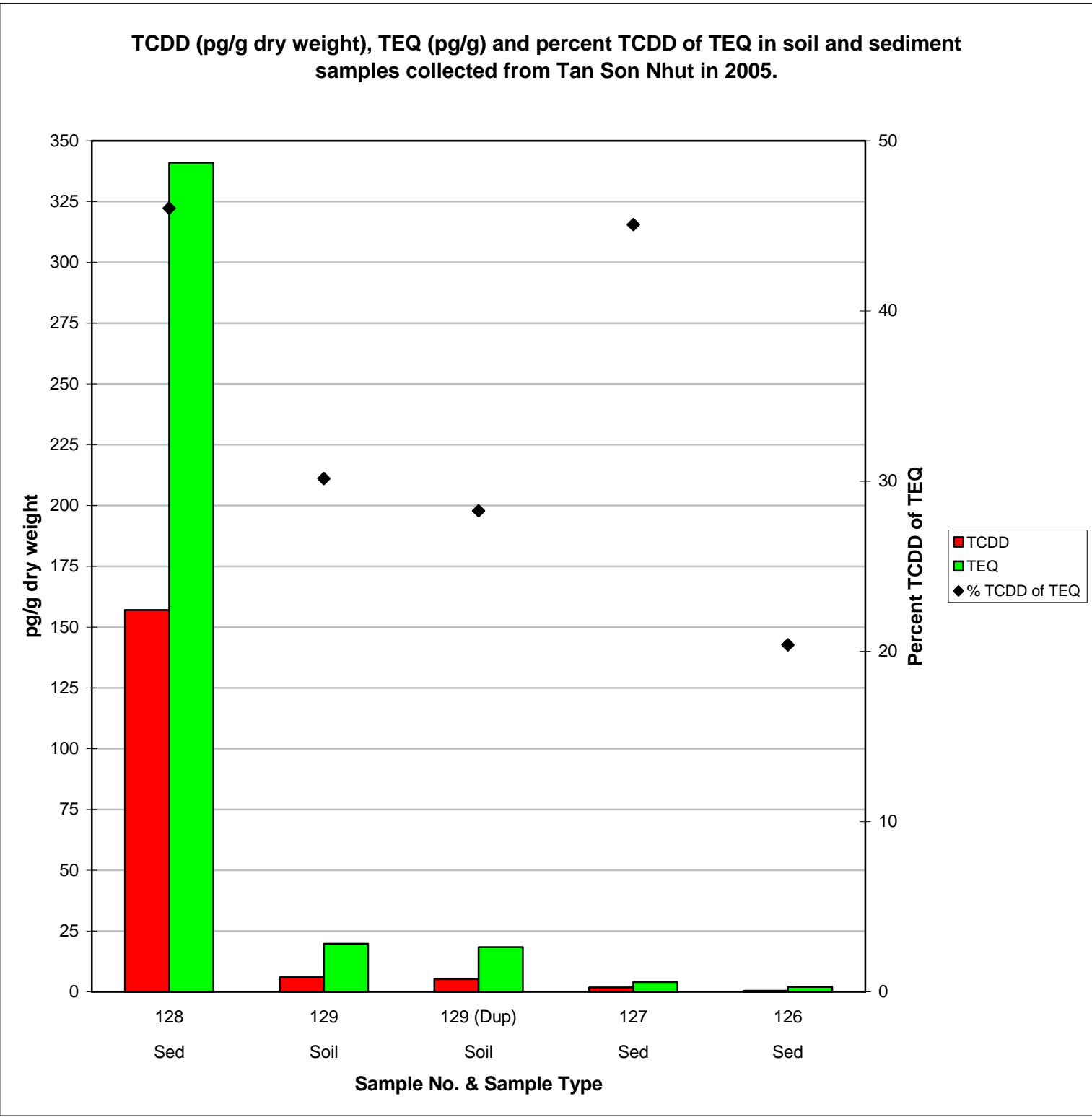
**Table 3.15 Concentrations of polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) in soil and sediment (pg/g [ppt] dry weight), Tan Son Nhut, Viet Nam, 2005.**

Sample ID	Sample Type	PCDD (pg/g dry weight)						PCDF (pg/g dry weight)						Total TEQ	TCDD as % of TEQ
		2,3,7,8-TCDD	Total T4CDD	Total P5CDD	Total H6CDD	Total H7CDD	Total O8CDD	2,3,7,8-TCDF	Total T4CDF	Total P5CDF	Total H6CDF	Total H7CDF	Total O8CDF		
05VN-128	Sediment	157	328	385	1640	7630	37400	36.9	501	555	873	1330	1070	341	46
05VN-129	Soil	5.97	12.1	18.5	112	817	4000	1.57	18.8	35.7	91.5	146	108	19.8	30
05VN-129 (Duplicate)	Soil	5.2	10.7	18.8	106	768	3650	1.74	20.8	34.8	85.9	138	102	18.4	28
05VN-127	Sediment	1.83	4.11	4.52	20	107	426	0.357	6.39	8.25	15.9	18	8.48	4.1	45
05VN-126	Sediment	0.42	3.4	3.03	12.1	72.7	324	0.29	8.08	7.73	12.3	15.1	8.46	2.06	20

**Table 3.16 2,3,7,8-TCDD (pg/g dry weight), TEQ (pg/g), and percent TCDD of the TEQ value for soil and sediment samples from Tan Son Nhut, Viet Nam, 2005.**

Sample ID	Sample Type	Location	TCDD	TEQ	% TCDD of TEQ
05VN128	sediment	ditch	157	341	46
05VN129	soil	natural vegetation	5.97	19.8	30
05VN129 (Duplicate)	soil	natural vegetation	5.2	18.4	28
05VN127	sediment	ditch	1.83	4.06	45
05VN126	sediment	ditch	0.42	2.06	20

Figure 3.7 Location of soil/sediment sample collection sites, and 2,3,7,8-TCDD data (pg/g, dry weight), Total TEQ, and percent TCDD of Total TEQ, *Tan Son Nhut*, Viet Nam, 2005.





## 4.0 CONCLUDING DISCUSSION AND RECOMMENDATIONS

After over a decade of research, the 10-80 Division (Viet Nam) and Hatfield Consultants Ltd. (Canada) have concluded that, in general, the residue levels of wartime Agent Orange/dioxin (2,3,7,8-TCDD) in the soils of southern Viet Nam are believed to be below that of background levels in the industrialized nations of North America and Western Europe. However, 10-80/Hatfield research has shown that there do remain significant hot spots of TCDD in select areas of southern Viet Nam.

The former US airbases at Da Nang, Phu Cat and Bien Hoa may be categorized as significant dioxin 'hot spots' on the basis of the 2,3,7,8-TCDD concentrations recorded in areas "downstream" of suspected Ranch Hand sites. Suspected "primary sites" were not sampled directly in this study due to restricted access by Vietnamese authorities. However, the distribution of elevated dioxin values (two groupings in Figure 3.5 for Bien Hoa) and point-specific values (Site 18 on Figure 3.1 for Da Nang; Site 8 on Figure 3.3 for Phu Cat), suggest significant involvement of Agent Orange herbicide in the overall toxicity of these soil/sediment samples.

A review of international guidelines for soils and sediments suggests that if the levels of TCDD and TEQ recorded at Da Nang, Phu Cat, and Bien Hoa were found in Europe and North America, remedial action and further investigations would be prescribed for these contaminated sites. However, in Viet Nam, given economic conditions and the need for people to harvest land-based crops and aquatic-based food products (e.g., fish and ducks), there is currently minimal capacity and funding for protecting against dioxin contamination. The issue of remediating dioxin contaminated lands/waterbodies has not been addressed in Viet Nam to any large degree to date.

The military bases eliminated as significant dioxin hot spots in this investigation were done so solely on the basis of dioxin levels recorded at sampling sites distributed near each installation. As noted above, 'primary' sites of contamination were not identified/sampled; therefore, even though a base has been categorized as not presently being a dioxin hot spot, there is potential that the base may be 'hot' if the exact location of Ranch Hand activities were pinpointed. Essentially, exclusion from the 'hot' category does not necessarily mean a former US military base in Viet Nam is, or should be, eliminated from the hot category – with more reliable infrastructural details of each base, its category may change.

For those bases identified as significant hot spots (Bien Hoa, Da Nang, and Phu Cat), certain strategies could be applied within each area to better understand the dioxin contamination issue and further protect local populations who may be exposed to elevated levels of dioxin. The approaches would, by necessity, be site-specific, although certain aspects would be common throughout. These strategies are described below. In addition, some comments are presented regarding the development of soil guidelines for Viet Nam.

## 4.1 BIEN HOA

Bien Hoa (Figure 3.5) is the most highly contaminated base of the three presented as potential dioxin hot spots in this investigation. In addition, the sampling design employed in this study has effectively pinpointed two separate dioxin “hot “ zones near Bien Hoa: Zone A (South Base Lake and Bien Hung Lake, and vicinities), and Zone B (near the eastern end of the runway). As a priority, Zone A should be the focus of comprehensive studies to determine health risk to local villagers. Further investigations should occur within Zone B to determine dioxin exposure pathways, if opportunities exist for humans to become contaminated with dioxin residues. If all the elements of a high risk potential exist (i.e., dioxin contaminant present, exposure pathways exist, and human receptors present), more comprehensive investigations should proceed in conjunction with those recommended for Zone A.

Near Zone A, eight communes are present (Quang Vinh, Trung Dung, Hoa Binh, Thanh Binh, Tan Tien, Thong Nhat, Ton Mai, and Quyet Thang). These communes should be involved in any future assessments of dioxin risk to human health. Certain communes may experience greater risk than others, given their size and population – Trung Dung, for example, in which the lakes are found, and in which the majority of people reside.

Over 900,000 people reside in the Bien Hoa area. Many of these local people have the potential to be exposed to dioxin residues. It is imperative that contaminated areas are documented and mitigative measures implemented.

The risk assessment program for Zone A near Bien Hoa base should include the following:

1. Undertake a socio-economic/health study of the communes to determine the actual number of families present that inhabit the area, names, ages of adults, number and ages of children, income, foods, use of lakes for food, health problems, duration of residence, previous residence locations, etc.
2. Determine the exact location of the herbicide storage/spill area on the base; collect and analyze soils from this highly contaminated site.
3. Collect and analyze biological samples from the lakes to determine dioxin contamination in common aquatic-based foods (e.g., fish and ducks; and others, if present).
4. Collect and analyze human blood and breast milk from representative populations near the lake to determine level and extent of human dioxin contamination.
5. Prepare a mitigation strategy for the area addressing soil, sediment, foods and human contamination from residual dioxin. The mitigation plan should involve extensive public awareness

campaigns using posters, brochures, videos, websites, workshops/seminars, radio, and TV. It would be through these information campaigns and direct mitigation activities toward contaminated terrestrial/aquatic environments that reduction in the exposure potential of local villagers can be realized.

6. Prepare appropriate recommendations for the physical remediation of contaminated lands/lakes. Remediation plans need to be designed in a manner which is appropriate to the unique local situation in Bien Hoa.

## **4.2 DA NANG**

The recommended strategy for the Da Nang area (Figure 3.1), and presented in the order of expected execution includes:

1. Determine the exact location of the Ranch Hand operational area.
2. Sample soils in the Ranch Hand area to determine dioxin contamination loads.
3. Follow drainage patterns from the specific Ranch Hand site, and collect and analyze sediments from these closely associated waterbodies to corroborate dioxin contamination.
4. Collect and analyze biological samples from waterbodies that are associated with these drainage patterns.
5. Collect and analyze biological samples from the vicinity of Sites 18 and 22 (Figure 3.1).
6. If there is an identification of high dioxin contaminant levels in food products in the study area, collect and analyze human samples (blood and breast milk).
7. Implement information programs (radio, TV, video, posters, workshops/seminars, etc.) for the general public and medical personnel on dioxin contamination and how people may protect themselves from such contamination.
8. Recommend cleanup programs for contaminated soils/sediments in a manner that would fit the economic profile of Viet Nam, and ultimately prevent the further contamination of local people.

Given the cooperative program between the USEPA and Viet Nam government at Da Nang, applicable information/data may be available to effect a rapid deployment of resources to undertake the strategies so outlined, and answer specific questions (e.g., positioning of the Ranch Hand area; data from USEPA soil sampling, etc.).

### 4.3 PHU CAT

The recommended strategy for Phu Cat (Figure 3.3) would involve many aspects similar to Da Nang; these include:

1. Collect and analyze soil samples from the suspected Ranch Hand site in order to determine dioxin contaminant loads.
2. Collect and analyze sediment samples near the entrance into South Lake originating from the “mitigation site”.
3. Collect and analyze biological samples from the lake.
4. If biological food samples contain significant levels of dioxin, collect and analyze human blood and breast milk from villagers inhabiting areas in the vicinity of South Lake; this program would be undertaken to determine the level and extent of human contamination.
5. Implement information programs for the general public and clinicians in the immediate area on dioxin contamination and protection strategies.
6. Recommend potential clean up methods for contaminated soils/sediments in a manner that would be commensurate with Viet Nam’s economic situation, which would ultimately prevent the further contamination of local people.

The Hot Spot study has highlighted the need for more comprehensive investigations near former US bases in southern Viet Nam. This study confirmed the existence of three significant hot spots, as well as four ‘new’ potential hot spots (Nha Trang, Can Tho, Tan Son Nhut and Pleiku). Others may exist, in former Ranch Hand operational areas. Contamination due to herbicide spills may be very discreet, not covering a large area. Information on base infrastructure is paramount for future sampling designs to be effective.

This study has set the foundation for other programs in southern Viet Nam where there may exist areas of dioxin contamination that pose a threat to human health. Protection of the local populations from residual dioxin contamination is of highest priority, particularly in Bien Hoa. Awareness raising campaigns are required to help reduce exposure of local residents to dioxins; plans for eventual clean-up of contaminated sites need to be formulated.

### 4.4 SOIL GUIDELINES FOR VIET NAM

As Viet Nam moves forward on developing accredited environmental laboratory facilities and becomes more familiar with international criteria for contaminated lands, a system of guidelines for toxic contaminants will be required. As

Table 3.1 (page 3-7) outlines, different jurisdictions have established a variety of toxic concentrations (TEQs) or TCDD levels for dioxin in soils, which, if exceeded, would trigger a given response.

For agricultural (or food-producing) soils, guidelines range from 2 pg/g TEQ in Finland to 10 pg/g TEQ (BC, Canada; the CCME, Canada; the Netherlands). Residential soils have guidelines that are more widespread ranging from 3.9 pg/g TCDD (USEPA – triggering a risk assessment if exceeded) to 1,000 pg/g TEQ (Germany and the Netherlands), with an action level of > 1,000 pg/g TEQ set by the ATSDR (Table 3.1, page 3-7).

The above-noted guidelines were adopted by their respective jurisdictions to minimize exposure to dioxin in the food chain, and ultimately protect human health. In all of the jurisdictions quoted, the association of humans to the land is significantly reduced when compared to Viet Nam. People living in the rural districts of Viet Nam often produce food on land they reside on, including chickens and ducks, which have potential for bioaccumulation of dioxin. Many families will raise fish in ponds, which are situated in close proximity to their homes. Children with bare feet and little clothing will play in potentially contaminated soils near homes. Children ingesting contaminated soil is highly probable in select areas of significant contamination.

In effect, there is justification to set dioxin soil guidelines for agricultural and residential lands in Viet Nam that are not widely different in terms of concentration. On the basis of guidelines presented in Table 3.1, 10 pg/g TEQ appears most often as a guideline for agricultural soils, and could be applied in Viet Nam, particularly in rural area.

For Viet Nam, a guideline for residential soils of 1,000 pg/g TEQ is considered too high, given the association of people to their land. Sweden and the CCME (Canada) have recommended 10 pg/g TEQ as a residential soil guideline as well. Exactly what the numbers should be for agricultural and residential soils can be debated. The BC (Canada) level of 350 pg/g TEQ set as a residential soil guideline is a reasonable compromise and could be applied in Viet Nam. However, given the marked difference in use of residential land by rural people in Viet Nam, compared to the west, it also seems reasonable that there exist different residential guidelines for dioxin in rural and urban settings. In rural residential areas, a 10 pg/g TEQ guideline could be applied, with urban settings being limited to a guideline of 350 pg/g TEQ.

Whatever guidelines are eventually selected for Viet Nam, the potential for human exposure to dioxins will be a major factor. The use of Agent Orange throughout Viet Nam, and on former US military installations, has set the stage for focusing on where concrete efforts should be expended to document dioxin contamination. Following from these objectives Viet Nam can eventually move forward on remediation efforts directed at the highly contaminated sites.

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## **APPENDICES**

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## **Appendix A1**

### **Field Reconnaissance Form**

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# Herbicide Site Field Investigation Form

Site: \_\_\_\_\_

## Site Information:

Date: \_\_\_\_\_

Time: \_\_\_\_\_

Project Site Name: \_\_\_\_\_ VN Site Name (if different): \_\_\_\_\_

District: \_\_\_\_\_ Commune: \_\_\_\_\_ Province: \_\_\_\_\_

US Military Name: \_\_\_\_\_

US Military Coords: UTM: \_\_\_\_\_ Zone: \_\_\_\_\_ dx: \_\_\_\_\_ dy: \_\_\_\_\_ Corps: I II III IV

Site Type: Airbase Airfield Heliport LZ Firebase Warehouse Transport Route

Other (specify): \_\_\_\_\_

US Occupation Dates/Groups: \_\_\_\_\_

Other Military Present: AVRN S. Korea Aussies NZ NVA Other: \_\_\_\_\_

## Logistics:

Field Crew: HCL: AA DM TB Other: \_\_\_\_\_

10-80: Dung Hung Thai Other: \_\_\_\_\_

Quaker: Lady Phuong Other: \_\_\_\_\_

VN Military: \_\_\_\_\_

VN Officials: \_\_\_\_\_

Weather: \_\_\_\_\_

Site Access: 2wd 4wd foot air boat comments: \_\_\_\_\_

Photographs taken: Yes No Type: digital film comments: \_\_\_\_\_

Video taken: Yes No Type: digital film comments: \_\_\_\_\_

Maps used: none available 1:250 1:50 base layout Other (specify): \_\_\_\_\_

Imagery used: none available Corona Ikonos Landsat Spot Other (specify): \_\_\_\_\_

Historic photographs available: Yes No Comments: \_\_\_\_\_

## Sampling

Samples taken: Yes No (see sampling section for details)

Samples type taken: soil sediment food human

# Herbicide Site Field Investigation Form

Site: \_\_\_\_\_

## Chemical Contamination Information:

Herbicide Use on Site: confirmed unconfirmed none

Herbicide Storage Area: Yes No unknown

Herbicide Sprayed Area: Yes No unknown

Herbicide Washdown Area: Yes No unknown

Herbicide Spray Method: Airplane Helicopter

Herbicide Staging Area: Yes No unknown

Backpack Boat

Type of Herbicide: AO Pink Purple White Blue unknown

Ranchhand Site: Yes No

Other chemicals on site: napalm anti-personnel none unknown Other: \_\_\_\_\_

Comments: \_\_\_\_\_  
\_\_\_\_\_

## UXO/Landmine Contamination Information:

Presence of : confirmed unconfirmed none

Cashes: clumped even distribution buried

Type: small bomb large bomb AP mines munitions Phosphorus Other: \_\_\_\_\_

Amount: few some many lots

Accidents: few some many lots

Locations: \_\_\_\_\_  
\_\_\_\_\_

Implications for Sampling: \_\_\_\_\_

## Demographics/Human Health

Level of information: Household Commune District

Nearest population group (km): \_\_\_\_\_

Age/sex (%): Men 29 or older \_\_\_\_\_

Estimated population: \_\_\_\_\_

Women 29 or older \_\_\_\_\_

Primary Income source for locals \_\_\_\_\_

Women younger than 29 \_\_\_\_\_

# of children/family: \_\_\_\_\_

Men younger than 29 \_\_\_\_\_

Children (<13 yrs) \_\_\_\_\_

Ethnic breakdown (%): Vietnamese: \_\_\_\_\_ Ethnic Minority: \_\_\_\_\_ (specify): \_\_\_\_\_

Healthcare available: # clinics \_\_\_\_\_ # hospitals \_\_\_\_\_ # nurses \_\_\_\_\_ # doctors \_\_\_\_\_ Nearest facility (km) \_\_\_\_\_

## Food

Primary protein: chicken cultured fish wild fish pork beef duck other: \_\_\_\_\_

Primary carb.: manioc rice wheat other: \_\_\_\_\_

Primary Local

food source: grown within household grown within commune grown within district imported from out of district

Food consumption patterns: protein every day protein 4-6 days/wk protein 1-3 days/wk protein <1day/wk

# Herbicide Site Field Investigation Form

Site:

## Hydrogeology

Land cover (%): Tree: \_\_\_\_\_ Shrub: \_\_\_\_\_ Grass: \_\_\_\_\_ Wetland: \_\_\_\_\_ Bare: \_\_\_\_\_ Anthro: \_\_\_\_\_ Agricult: \_\_\_\_\_

Land shape: concave convex sloped flat Aspect: north south east west

Soil Type: sandy loam ferrous description: \_\_\_\_\_

Compaction: hard med hard medium medium soft loose Flood hazard: none rare moderate frequent

Site gradient (%): \_\_\_\_\_ Crown closure (%) \_\_\_\_\_ Ponding/dyking: none few moderate many

Features (mntns, rivers, lakes, estuary): \_\_\_\_\_

Implications for sampling: \_\_\_\_\_

## Land Use

Total size of area surveyed (ha): \_\_\_\_\_

Land Use %: Urban: \_\_\_\_\_ Residential: \_\_\_\_\_ Agricultural: \_\_\_\_\_ Industrial: \_\_\_\_\_ Forestry: \_\_\_\_\_

Land Use Description (types by group) \_\_\_\_\_

## Sampling

Sample Type	Canada ID	VN ID	Comments/coords

# Herbicide Site Field Investigation Form

Site:

## Sketch

Write coordinates on sketch

## Overall Assessment

1. Likelihood of contamination	None	low	moderate	high	very high	unk.
2. Potential risk to human health	None	low	moderate	high	very high	unk.
3. Known birth defects and Dioxin related illness	None	low	moderate	high	very high	unk.
4. Visible AO related waste	None	low	moderate	high	very high	unk.
5. Available information on AO Activities	None	low	moderate	high	very high	unk.
6. UXO Contamination	None	low	moderate	high	very high	unk.
7. Sampling Difficulty	None	low	moderate	high	very high	unk.

Future efforts:



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**Appendix A2**  
**Field Sampling Form**

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## VN1071 Ford Foundation Phase II Field Sheet

Sample #(s):	Date and Time:	Photos taken by:
Airbase Name:	District Name:	
UTM of Site:	Commune Name:	
Identifiable feature near site:  Description: _____ _____ _____	Sample Type:    Soil       Sediment       Other	Comp of:
UTM:	Sample Pattern:    square       round       line       grab       other	
	Sample Method:       core       trowel       hand       Eckman	
	Description of Soil Type:	

Description of area around sample site (i.e., type of use, population, topography, hydrology):

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Site Sketch:

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## **Appendix A3**

### **Imagery for the Priority Sampling Areas**

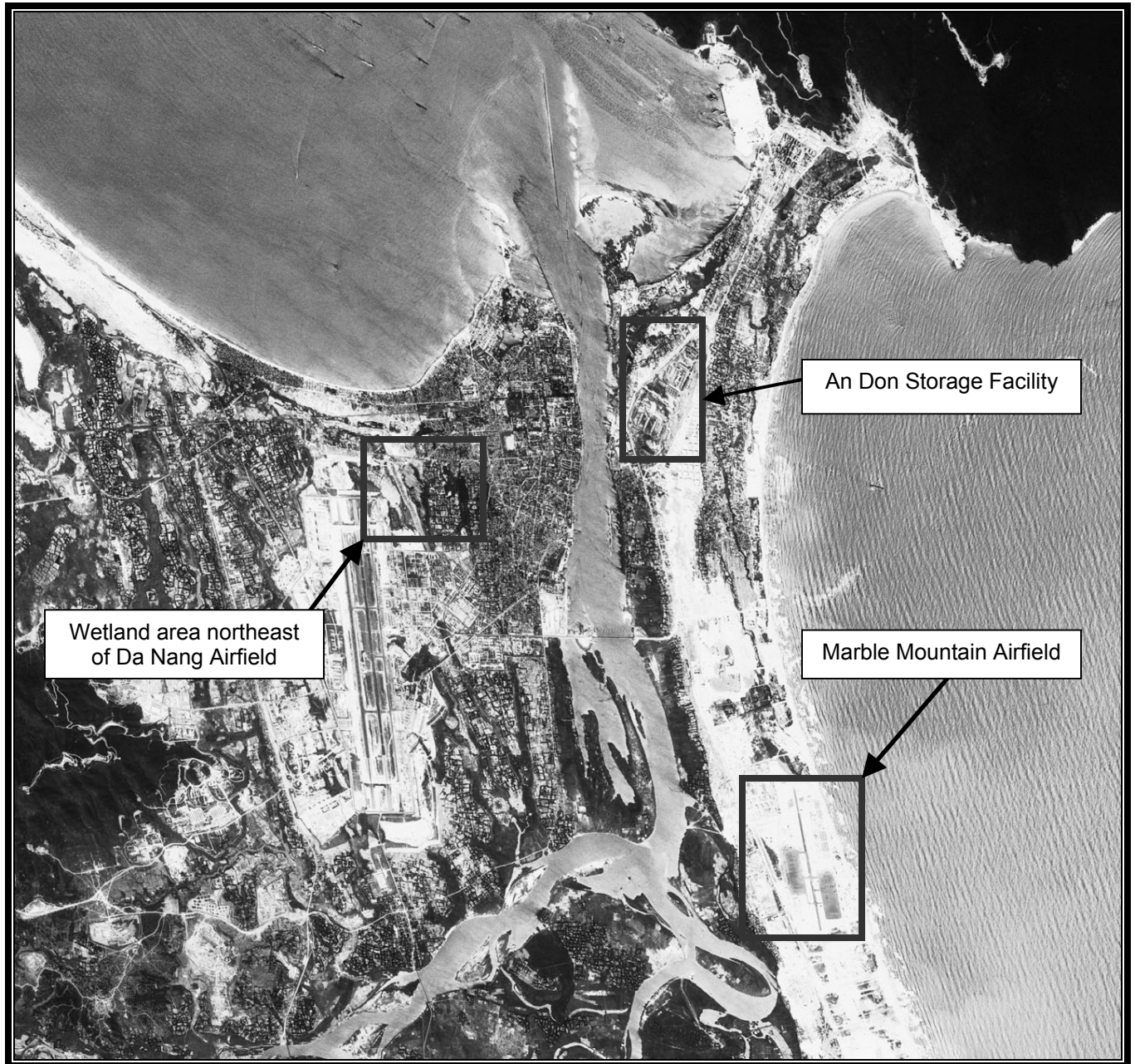
- A3.1 Da Nang**
  - A3.2 Pleiku**
  - A3.3 Phu Cat**
  - A3.4 Nha Trang**
  - A3.5 Bien Hoa**
  - A3.6 Can Tho**
  - A3.7 Tan Son Nhut**
-

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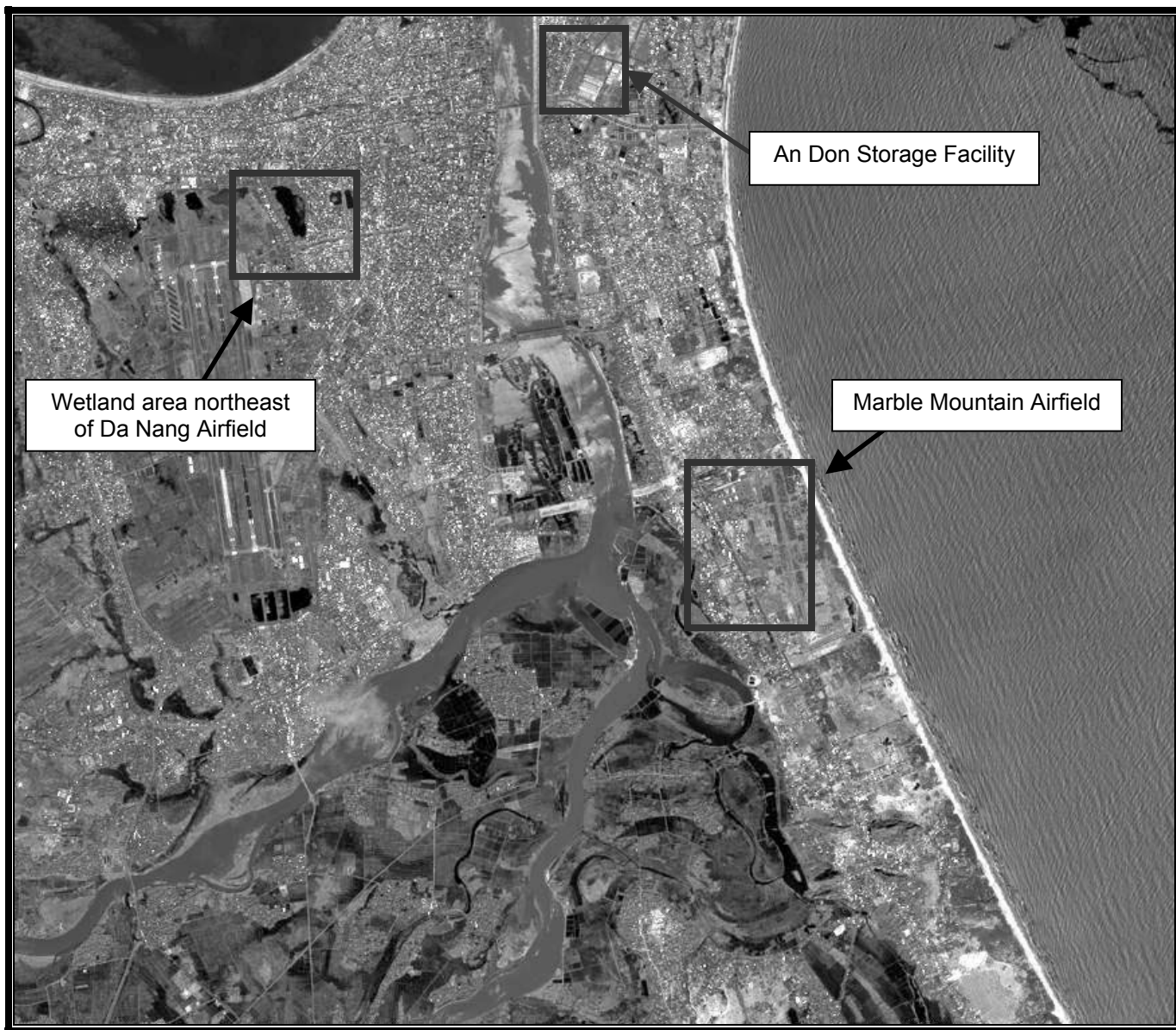
## **Appendix A3.1**

### **Da Nang Area**

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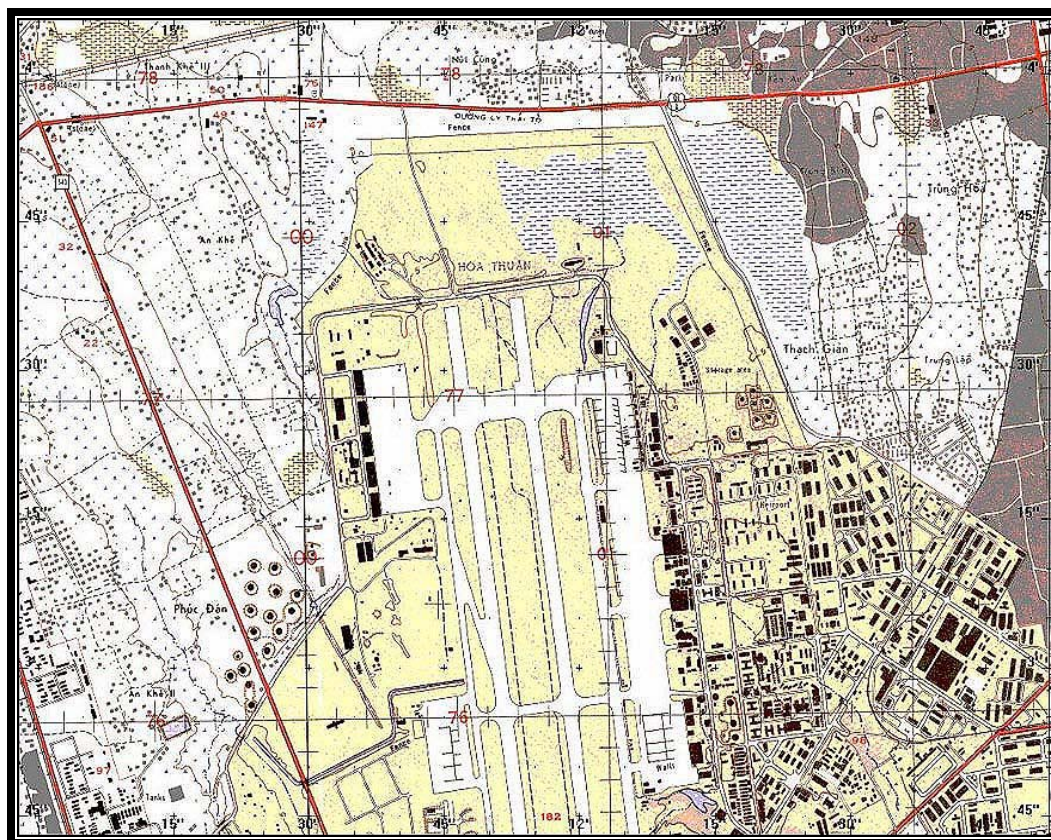


Corona satellite image of Da Nang, 1967.

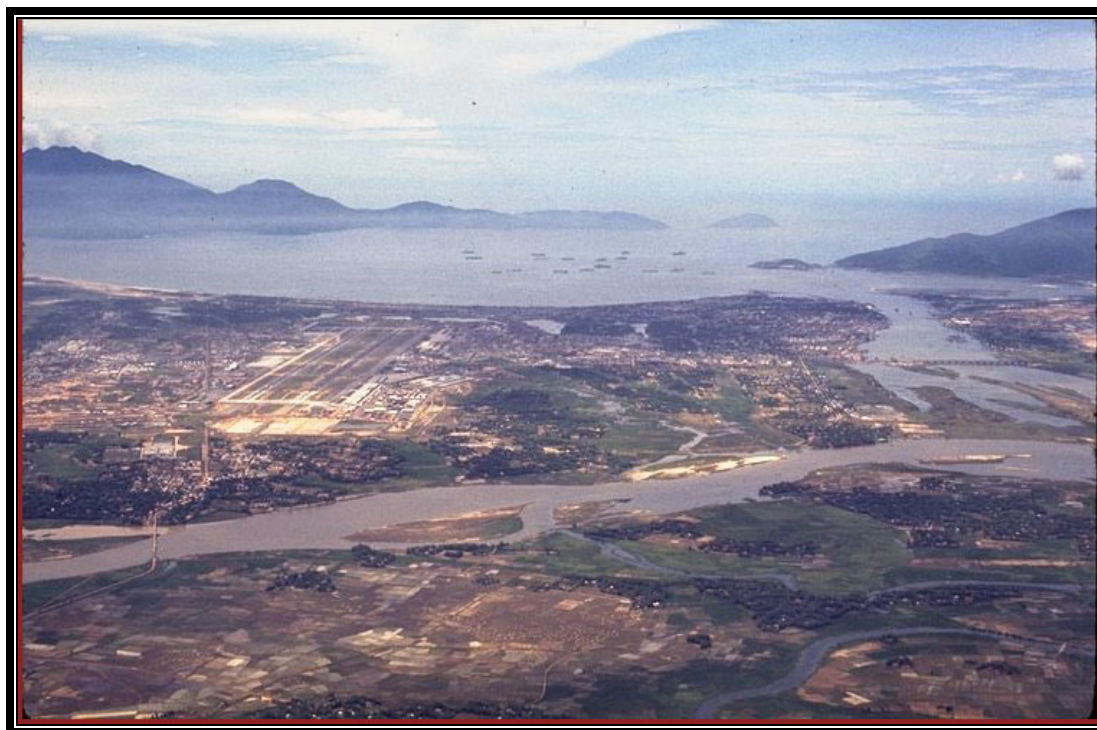


Ikonos satellite image of Da Nang, 2003.



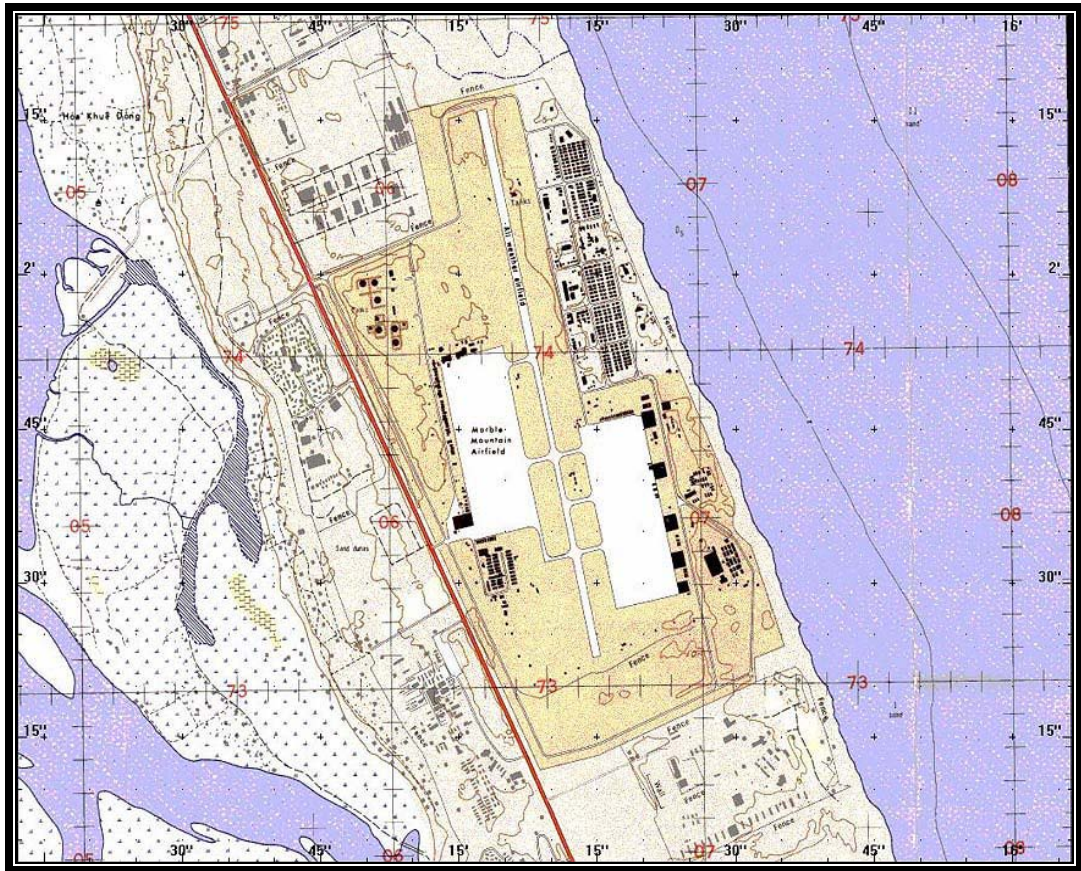


Map of north end of Da Nang Airbase, 1970 (1:50,000 scale).



Aerial photograph of Da Nang, 1969.





**Map of Marble Mountain Airfield, 1970 (1:50,000 scale).**

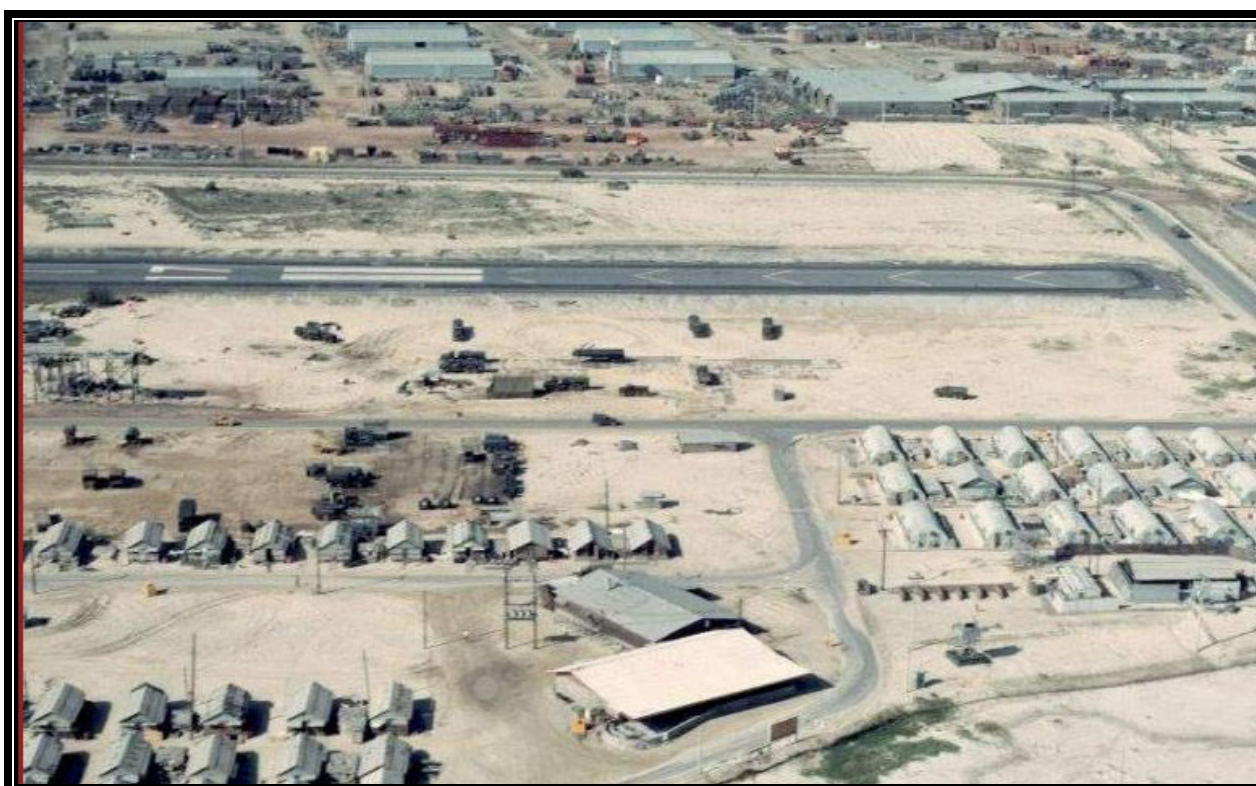


**Aerial photograph of Marble Mtn. Airfield, 1967.**





Aerial photograph of Marble Mtn. Airfield, 1970.



Aerial photograph of Marble Mtn. Airfield, 1969.



**A photograph of former An Don storage facility, February 2004.**



**A photograph of the outside of the former An Don storage facility, February 2004.**





**Newly created lake/park area located immediately east of the north end of Da Nang Airbase, February 2004**



**Local inhabitant fishing in the lake, February 2004**

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## **Appendix A3.2**

### **Gai Lai (Pleiku) Area**

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Corona satellite image of Pleiku Area, 1967.





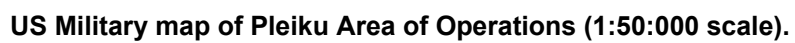
Copyright © 2000 Bob Payne

Pleiku Airbase approach from the west, 1971.



Aerial photograph of Pleiku Airbase looking south, 1970.





**US Military map of Pleiku Area of Operations (1:50:000 scale).**





Large scale US Military map of Pleiku Area of Operations (1:250,000 scale).



Aerial photograph of Camp Holloway, 1968.



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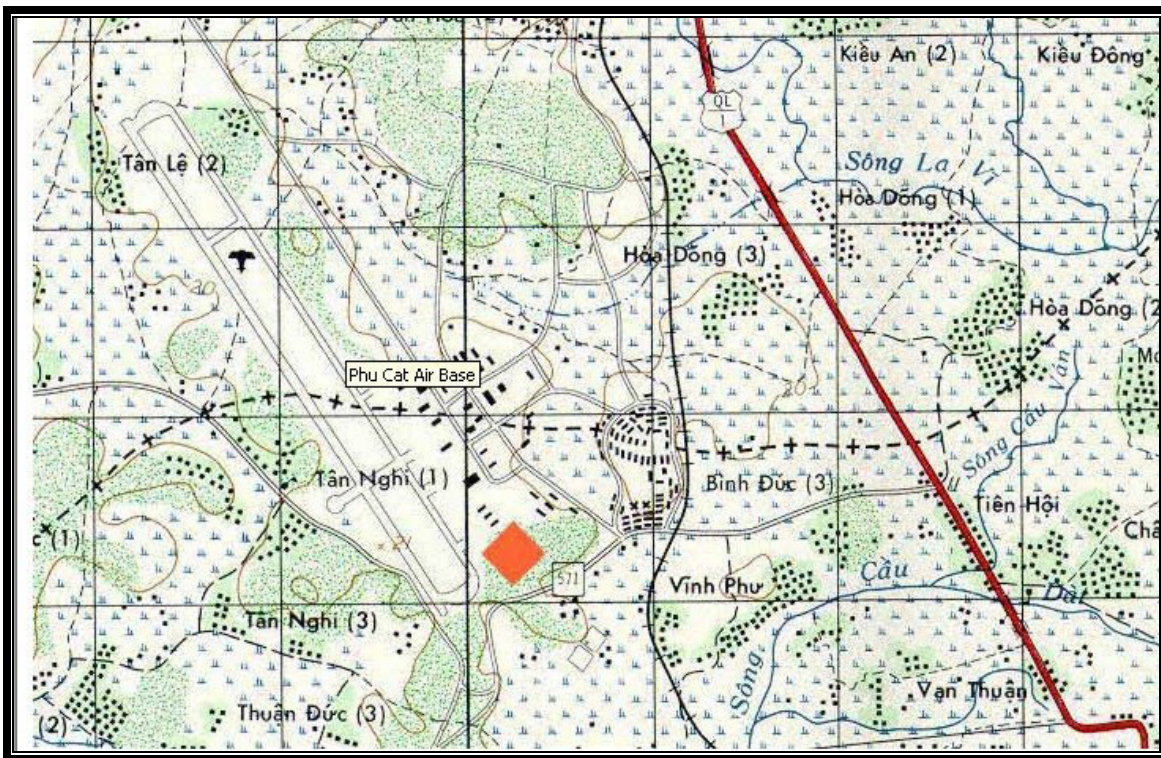
## **Appendix A3.3**

### **Binh Dinh (Phu Cat / Qui Nhon) Area**

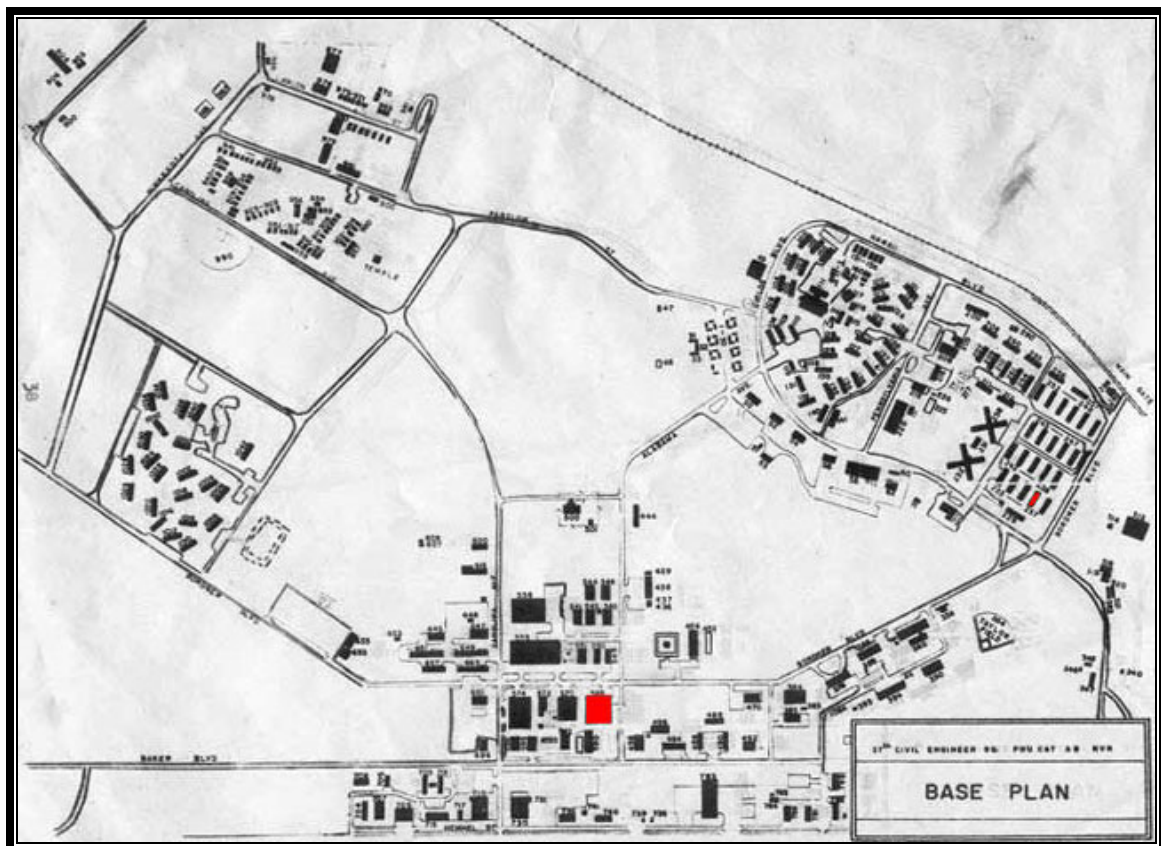
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Corona satellite image of Qui Nhon area, 1969.

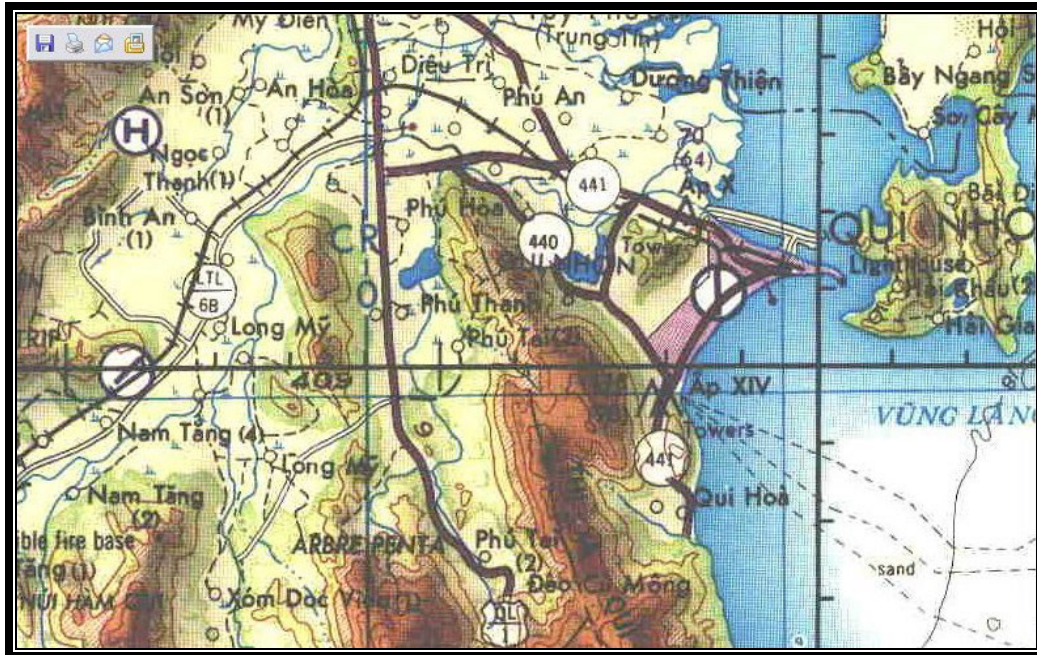


US Military map of Phu Cat Airbase (1:50,000 scale).



US Military base plan of Phu Cat Airbase.



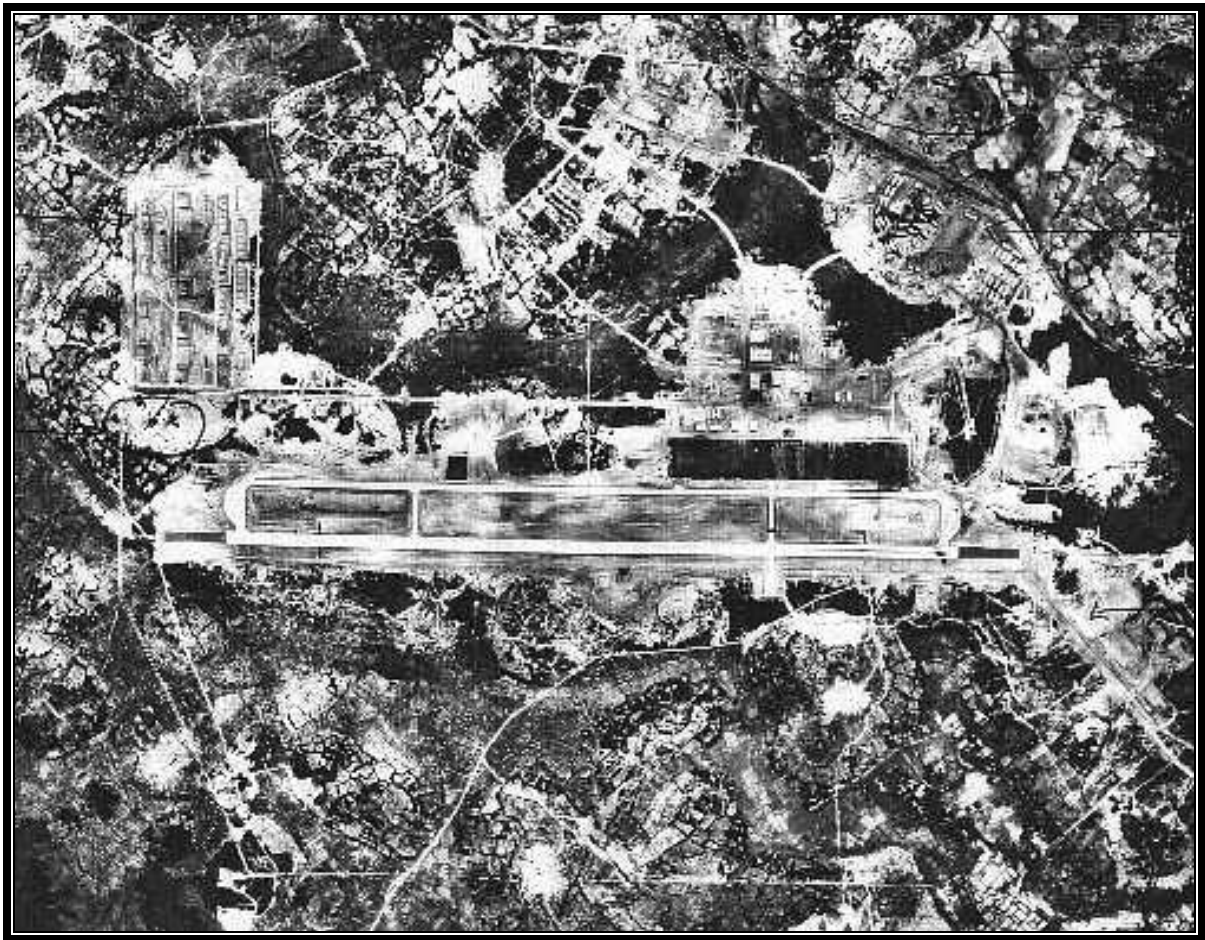


US Military map of Qui Nhon Area of Operations, 1969 (1:250,000 scale).



Aerial photograph of Phu Cat Airbase (date unknown).





**Aerial photograph of Phu Cat Airbase, 1967.**



**Aerial photograph of a US Firebase near Phu Cat.**





**Aerial photograph of Qui Nhon Airfield, 1971.**



**Aerial photograph of Phu Cat Airfield, 1971.**



**Waterway downstream of South Lake irrigation dam eventually leading to rice paddies. Phu Cat base in the background.**



**Ducks feeding in rice paddies downstream of South Lake irrigation dam, Phu Cat.**



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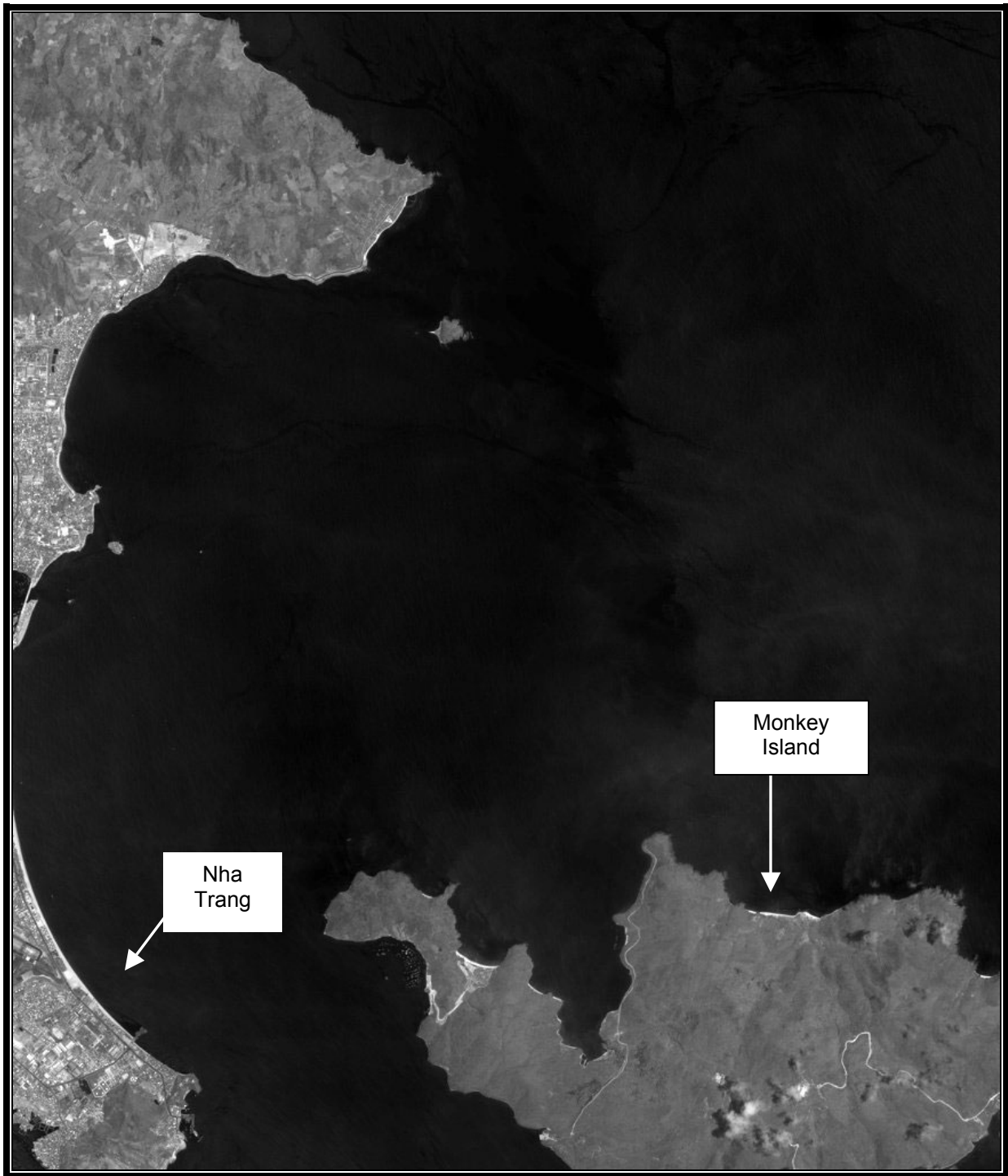
## **Appendix A3.4**

### **Khanh Hoa (Nha Trang / Cam Ranh) Area**

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Corona satellite image of Nha Trang, 1967.

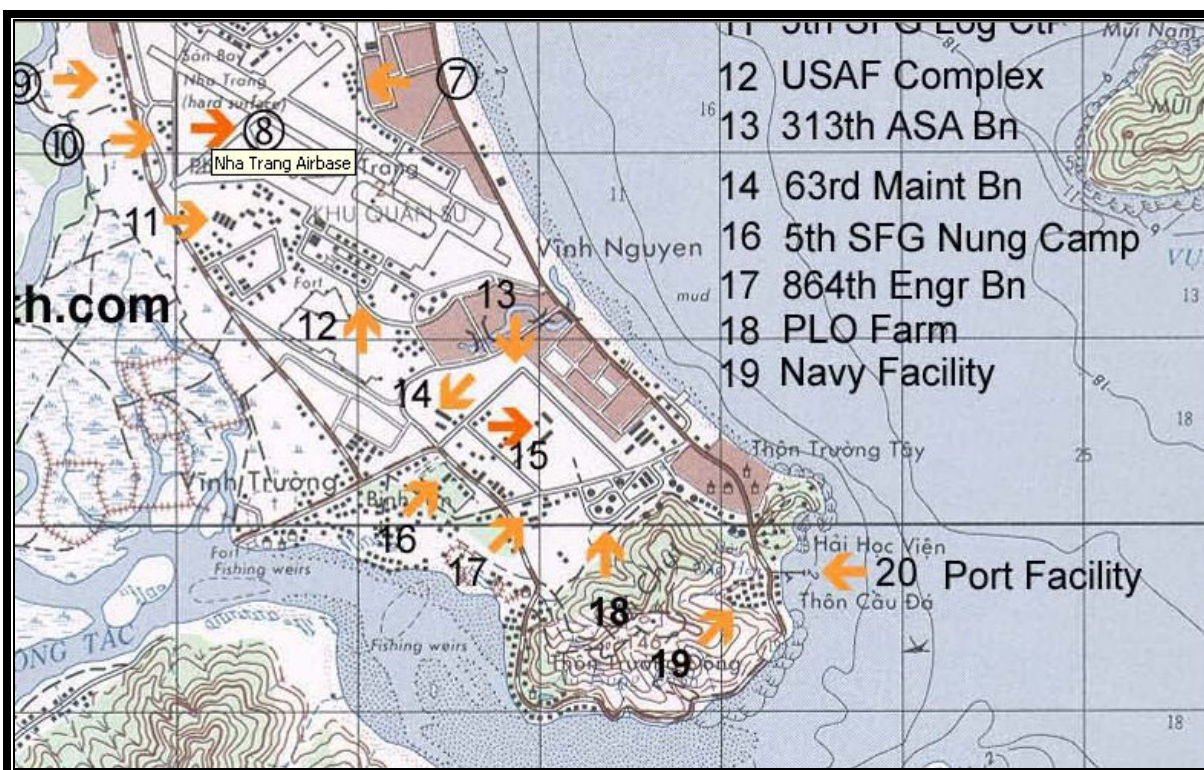


**Ikonos satellite image of Nha Trang, 2002.**





**US Military map of Nha Trang area (1:250,000 scale).**



**US Military map of the south end of Nha Trang (1:50,000 scale).**



**Aerial photograph of Nha Trang Harbour, 1969.**



**Aerial photograph of Nha Trang Airbase, 1970.**





**Dong Ba Thin Airstrip, March 2004**



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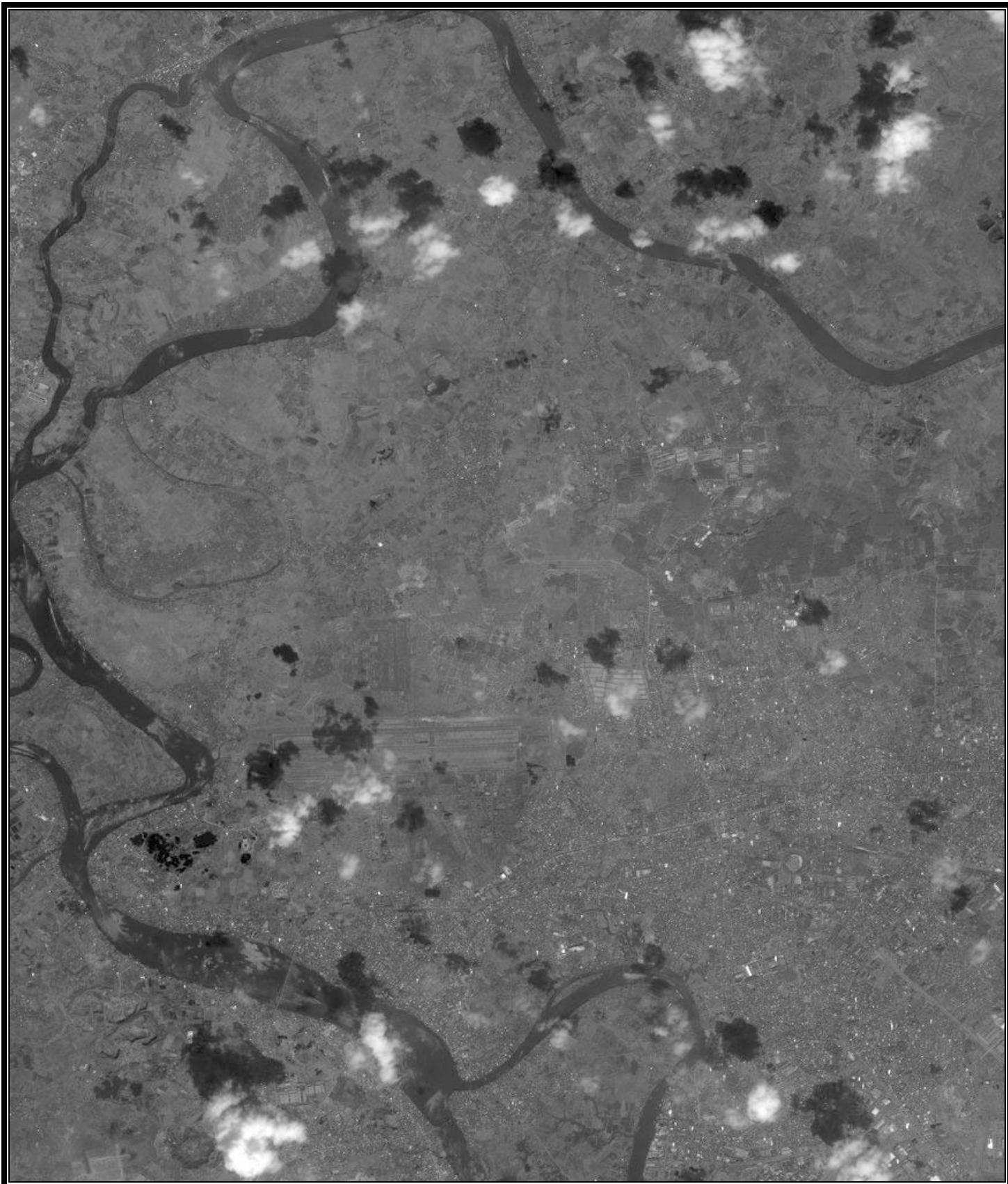
## **Appendix A3.5**

### **Dong Nai (Bien Hoa / Long Binh) Area**

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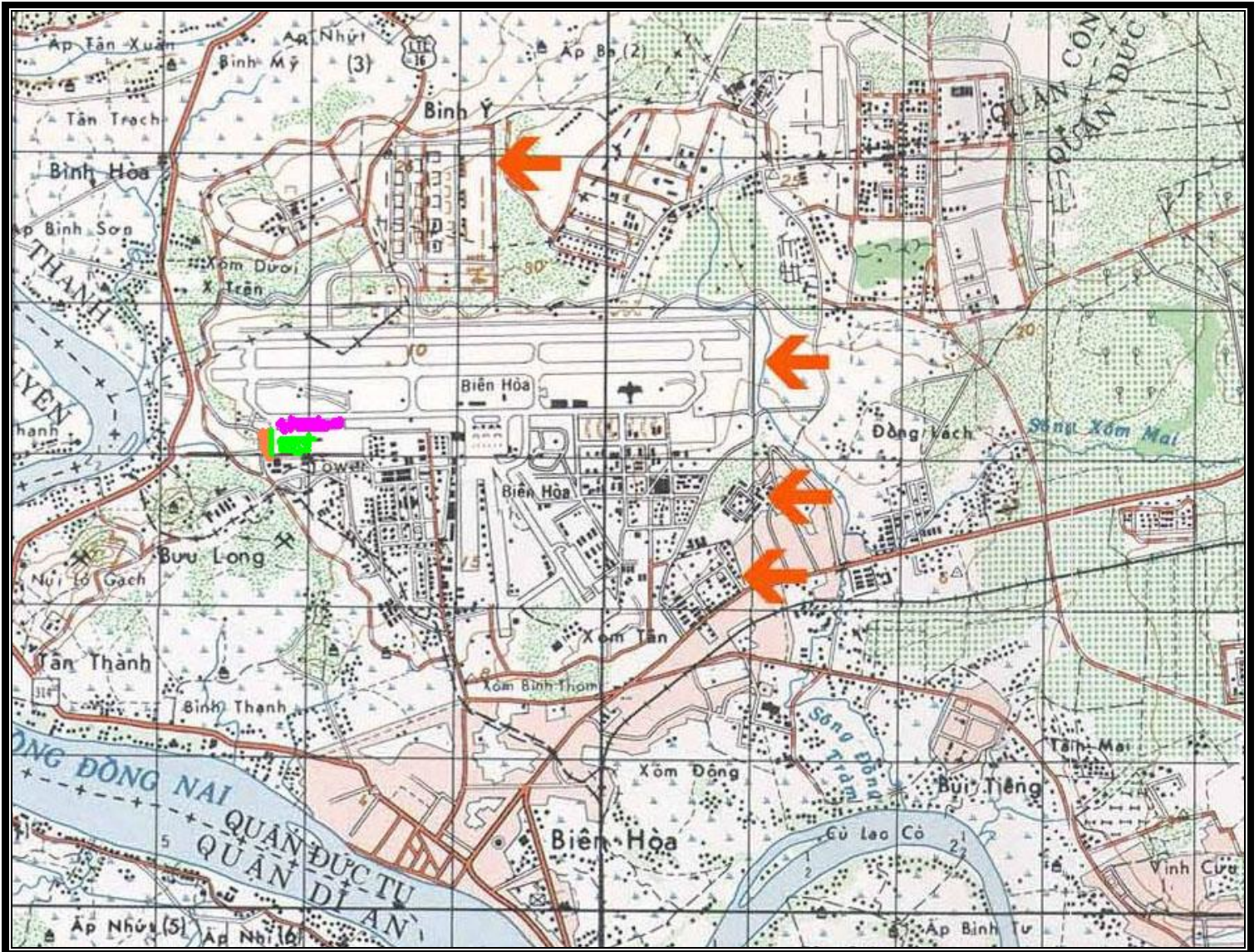


Corona satellite image of Bien Hoa and Long Binh Area, 1969.



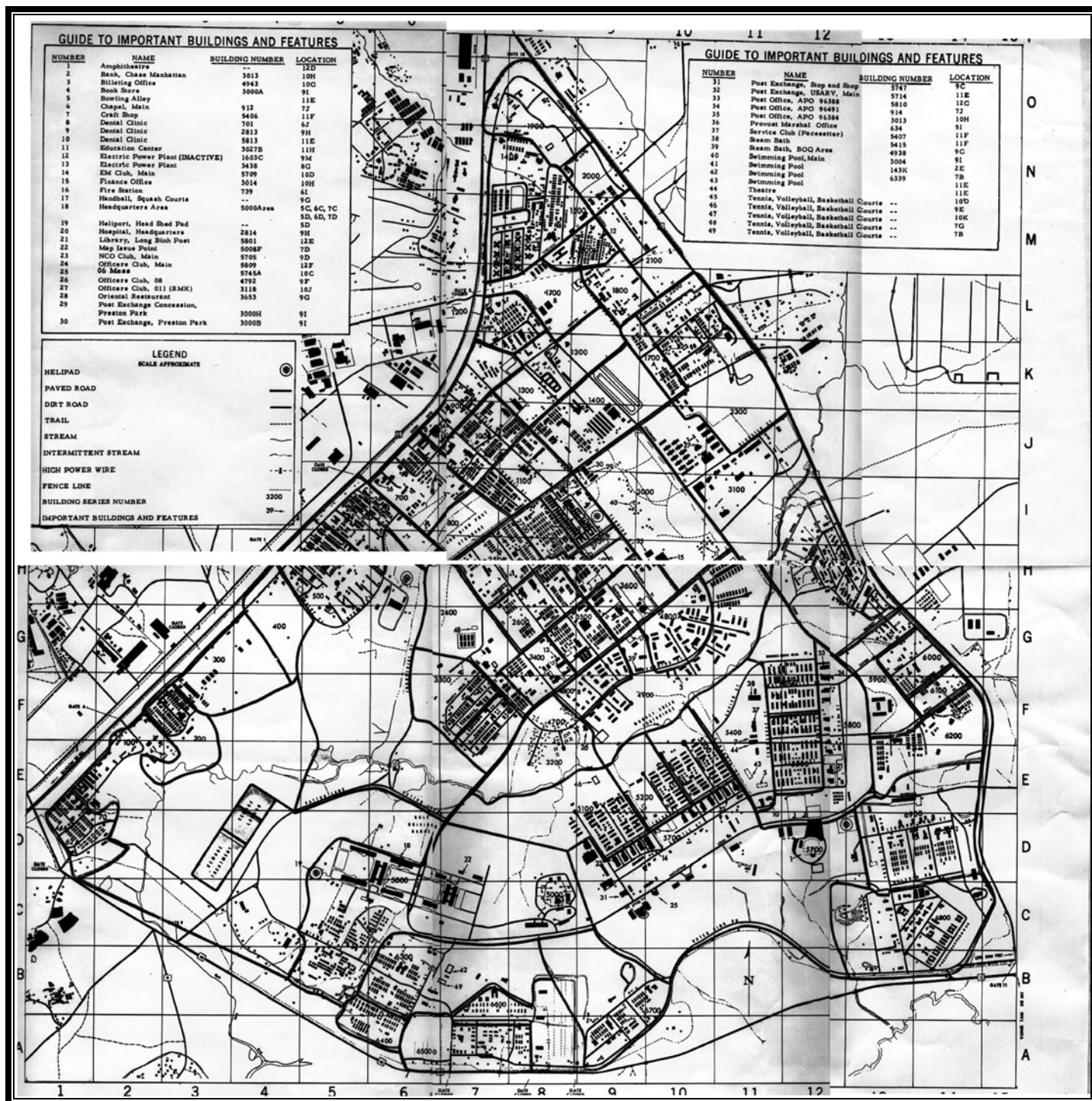
Ikonos satellite image of Bien Hoa area, 2002.



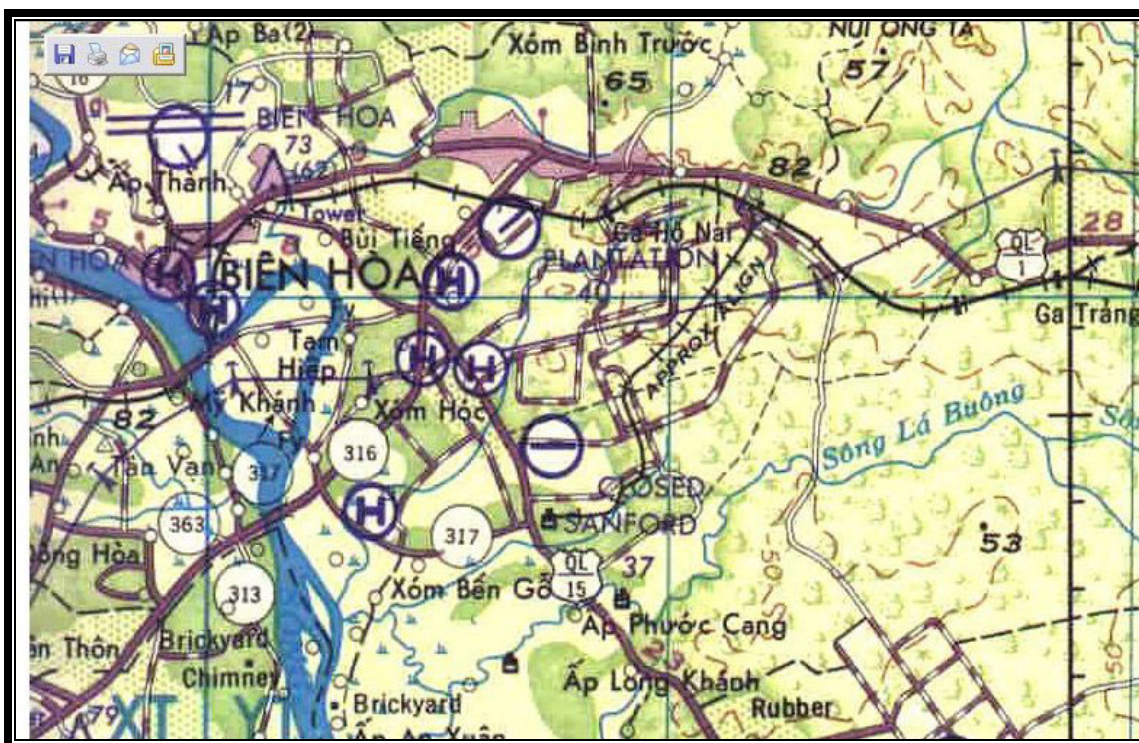


US Military map of Bien Hoa Area of Operations (1:50,000 scale). Note: the orange arrows have no meaning in this study; they were present on the original diagram.





US Military base plan of Long Binh Depot, 1972.



US Military map of Bien Hoa/Long Binh Area of Operations (1:250,000 scale).



Aerial photograph of Bien Hoa herbicide loading area, 1969.





**Aerial photograph of Long Binh Depot, 1970.**



**Aerial photograph of Long Binh Depot, 1967.**



Ground photographs of Bien Hoa herbicide loading area, (date unknown).





**Bien Hung Lake (north end) wetland near entrance of drainage flow from South Base Lake.**



**Southern end of Bien Hung Lake.**

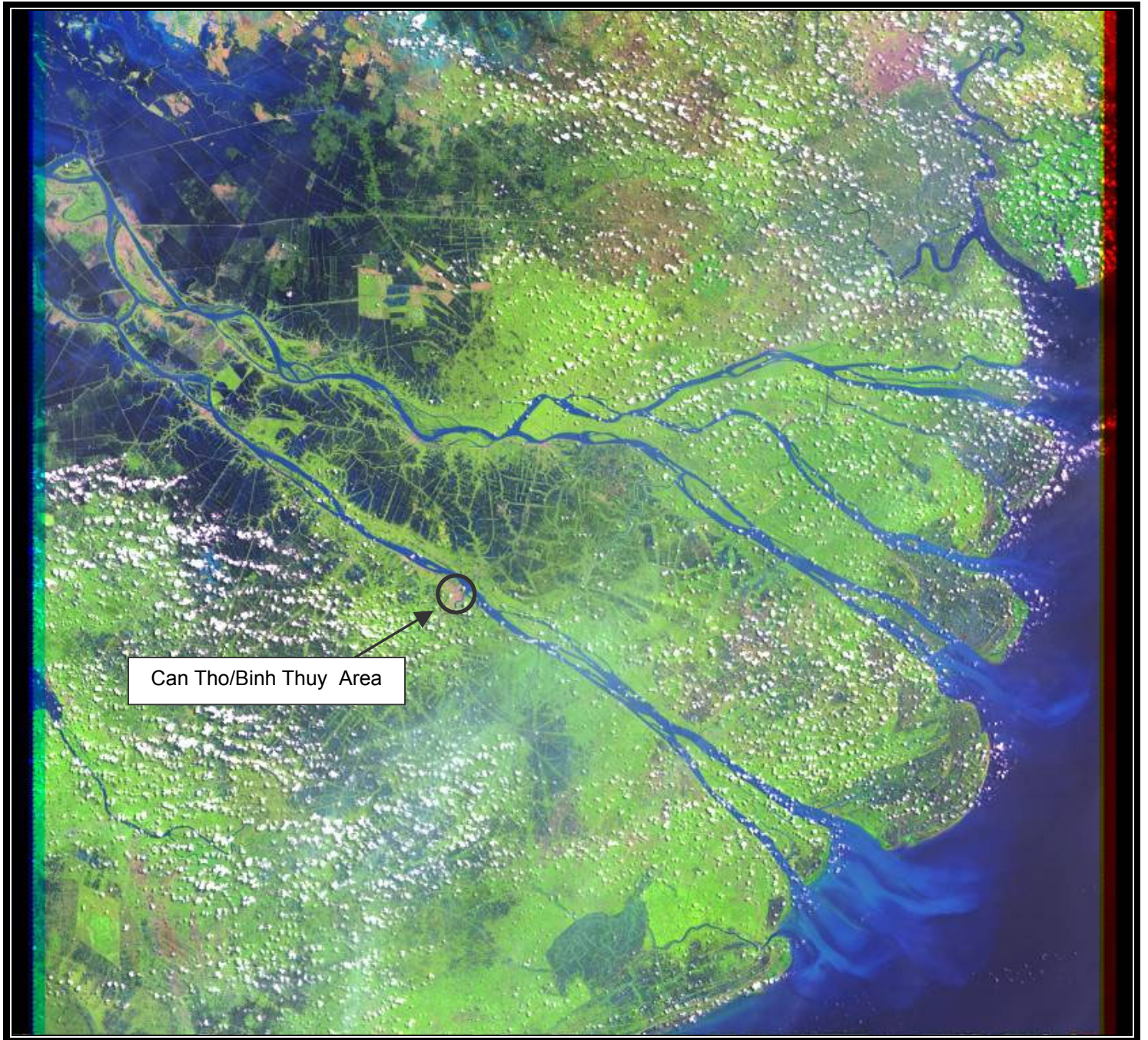
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## **Appendix A3.6**

### **Can Tho Area**

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Landsat satellite image of the Mekong River Delta and Can Tho/Binh Thuy, 2000.





Aerial photograph of Can Tho Airfield, 1967.



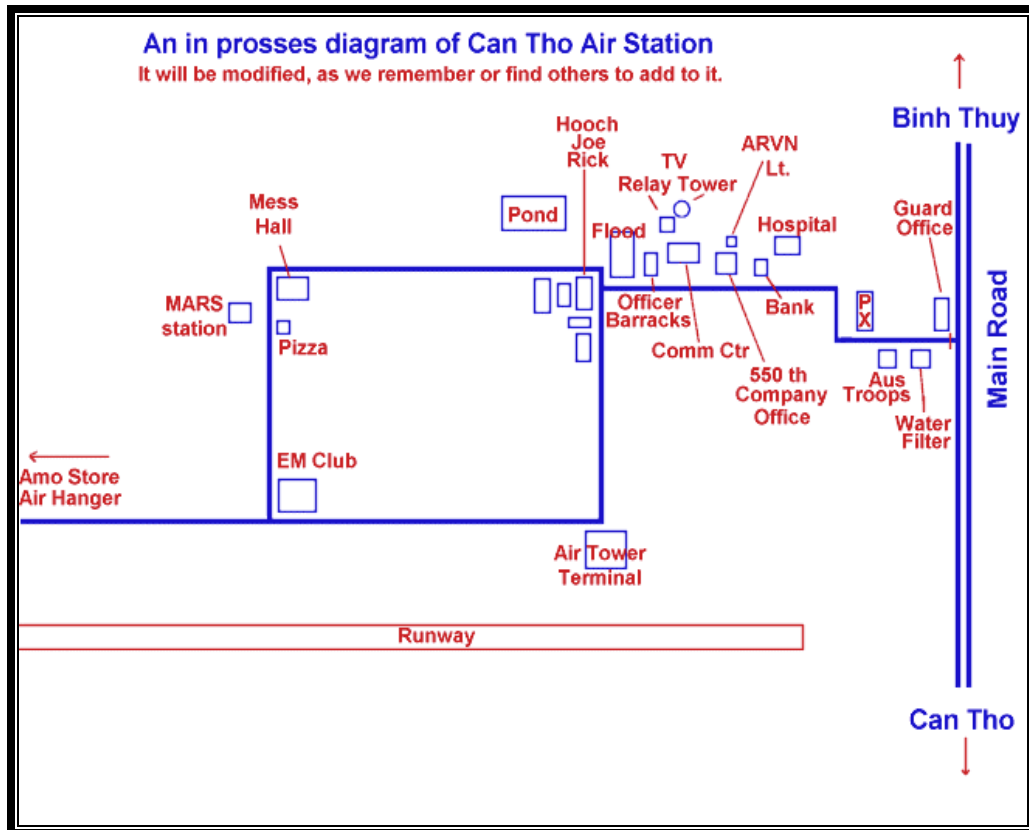
Can Tho Airfield runway, 1969.



Aerial photograph of Can Tho Airfield, 1968.



Photograph of Binh Thuy Airfield, 1968.



Can Tho Airfield base plan, 1969.



Lake/Wetland area immediately east of the end of Can Tho Airport runway,  
March 2004

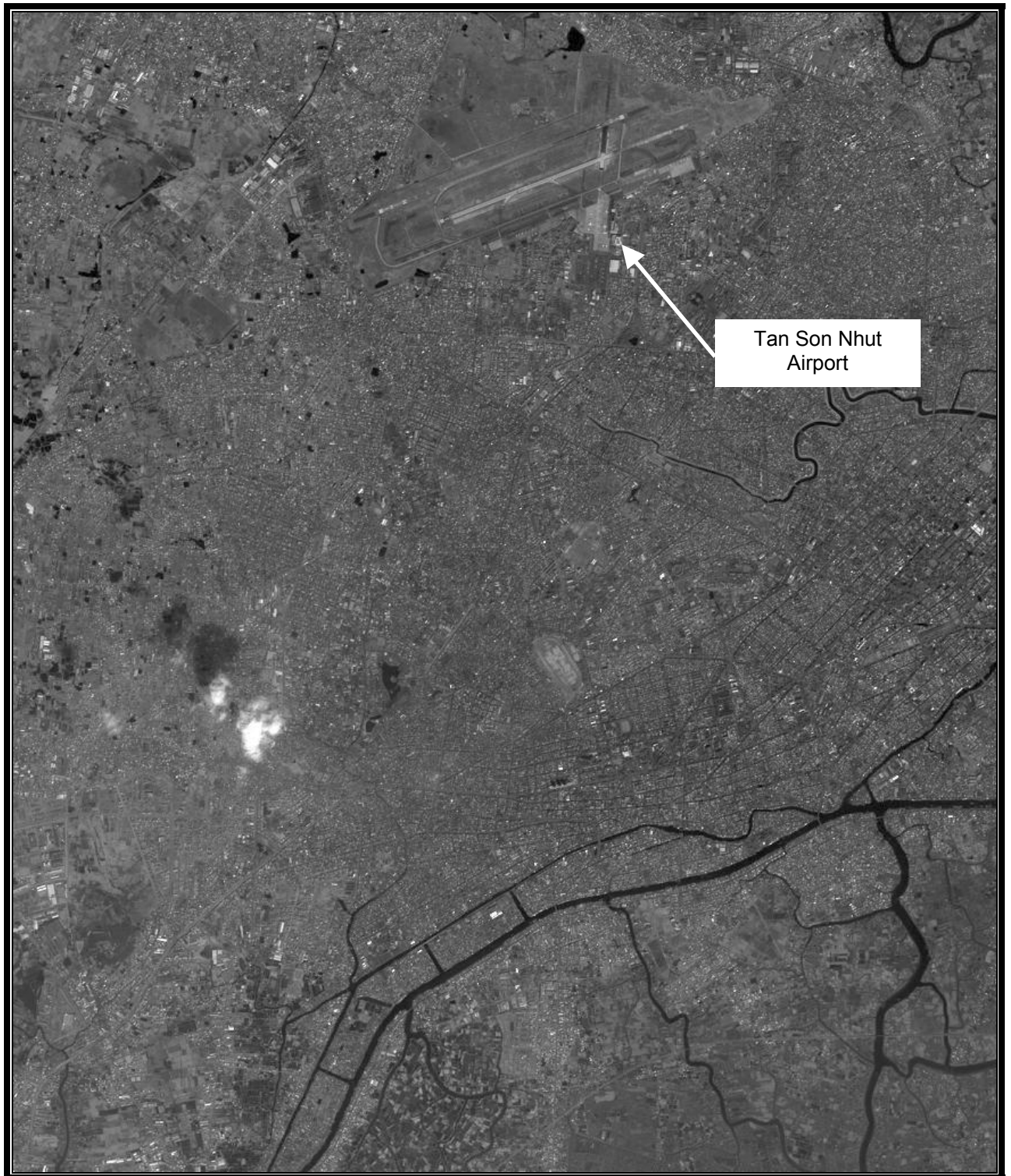
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## **Appendix A3.7**

### **Tan Son Nhut / HCMC Area**

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**Air Photo of Tan Son Nhut Airfield and Ho Chi Minh City, 2003.**

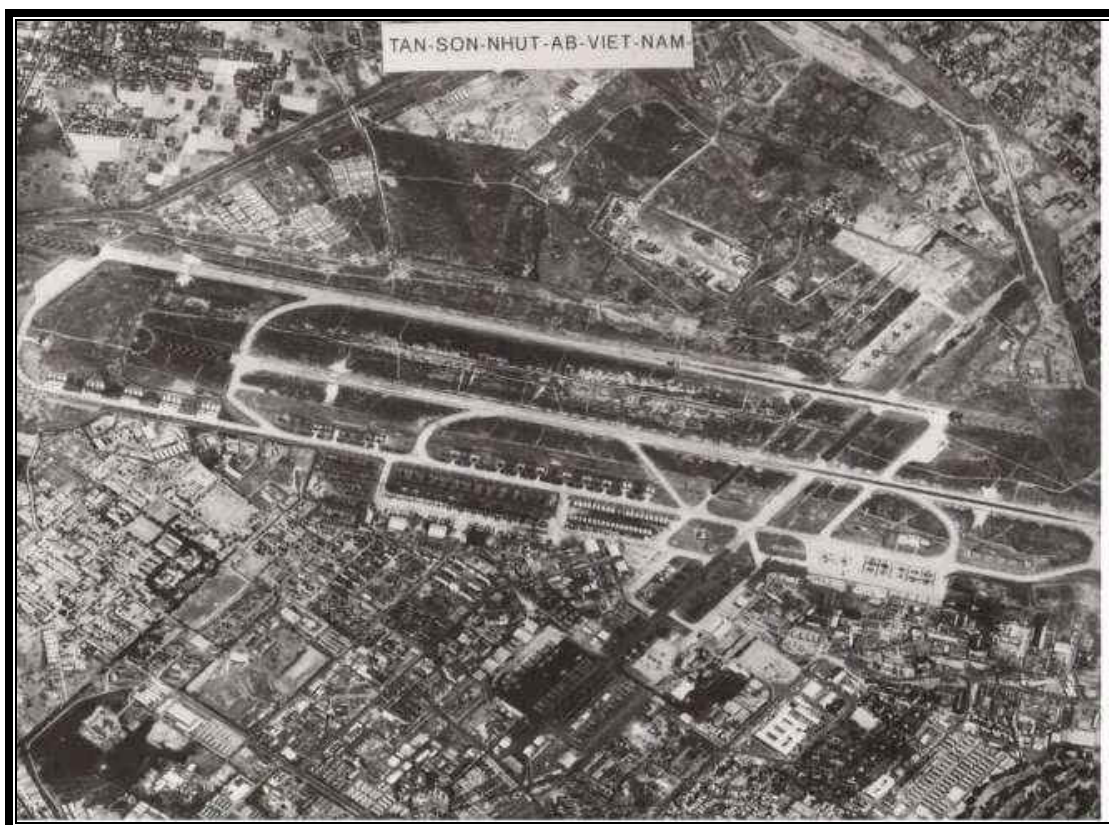




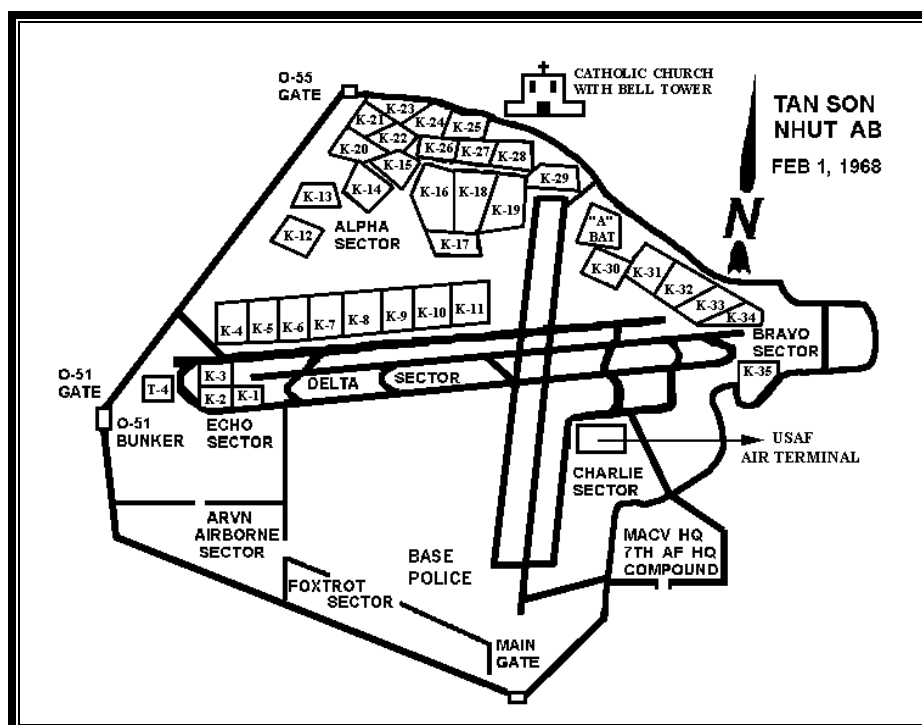
Ikonos satellite image of Tan Son Nhut Airbase, 2002.



Ikonos satellite image of Tan Son Nhut Airbase, 2002.

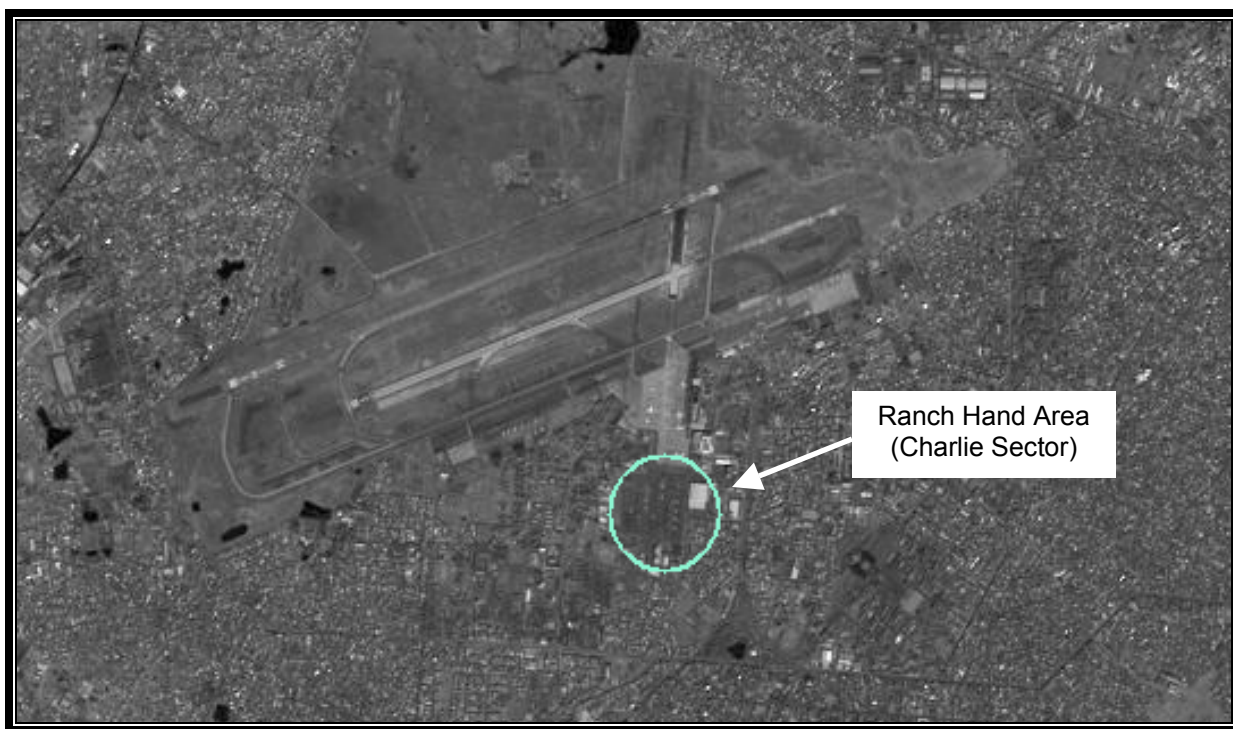


Aerial photograph of Tan Son Nhut Airbase, 1968.

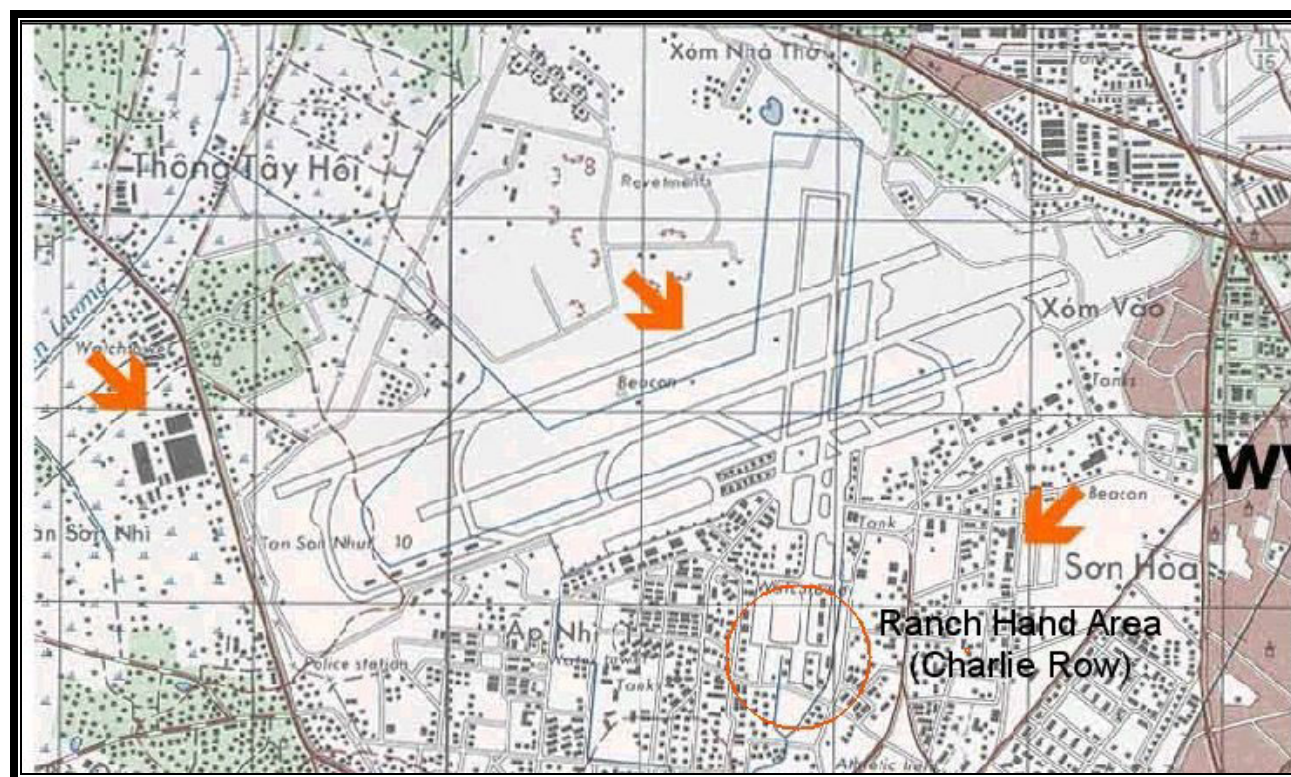


Base Map of Tan Son Nhut Airbase, 1968.





Ikonos satellite image of Tan Son Nhut Airbase (2003) showing former Ranch Hand Area.



US Military Map of Tan Son Nhut Airbase (1:50,000 scale).

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## **Appendix A4**

### **Dioxin Data AXYS Analytical Services Ltd.**

<b>A4.1</b>	<b>Da Nang</b>
<b>A4.2</b>	<b>Pleiku</b>
<b>A4.3</b>	<b>Phu Cat</b>
<b>A4.4</b>	<b>Nha Trang</b>
<b>A4.5</b>	<b>Bien Hoa</b>
<b>A4.6</b>	<b>Can Tho</b>
<b>A4.7</b>	<b>Tan Son Nhut</b>
<b>A4.8</b>	<b>QA/QC Sheets</b>

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## **Appendix A4.1**

### **Dioxin Data: Da Nang**

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**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-001	<b>AXYS FILE:</b>	L8155-1 R
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	21-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 11
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	10-Nov-2005
<b>SAMPLE SIZE:</b>	10.7 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
		<b>ANALYSIS DATE:</b>	20-Nov-2005
<b>% Moisture:</b>	45.5	<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	27.0	0.0470	
1,2,3,7,8-PECDD	1.61	0.0470	
1,2,3,4,7,8-HXCDD	2.65	0.140	
1,2,3,6,7,8-HXCDD	6.79	0.140	
1,2,3,7,8,9-HXCDD	11.2	0.140	
1,2,3,4,6,7,8-HPCDD	221	0.112	
OCDD	3970	0.469	
2,3,7,8-TCDF *	1.45	0.0470	
1,2,3,7,8-PECDF	0.568	0.0470	
2,3,4,7,8-PECDF	0.716	0.0470	
1,2,3,4,7,8-HXCDF	1.85	0.0470	
1,2,3,6,7,8-HXCDF	1.17	0.0470	
2,3,4,6,7,8-HXCDF	0.748	0.0470	
1,2,3,7,8,9-HXCDF	0.141	0.0470	
1,2,3,4,6,7,8-HPCDF	12.6	0.0470	
1,2,3,4,7,8,9-HPCDF	0.899	0.0470	
OCDF	21.6	0.0470	
TOTAL TETRA-DIOXINS	58.9	0.0470	
TOTAL PENTA-DIOXINS	23.7	0.0470	
TOTAL HEXA-DIOXINS	96.4	0.140	
TOTAL HEPTA-DIOXINS	441	0.112	
TOTAL TETRA-FURANS	12.0	0.112	
TOTAL PENTA-FURANS	16.3	0.0470	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)
TOTAL HEXA-FURANS	25.0	0.0470	2,3,7,8-TCDD TEQs (ND=0) = 34.3
TOTAL HEPTA-FURANS	31.7	0.0470	2,3,7,8-TCDD TEQs (ND=1/2 DL) = 34.3

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	77.6
13C-1,2,3,7,8-PECDD	78.6
13C-1,2,3,6,7,8-HXCDD	77.8
13C-1,2,3,4,6,7,8-HPCDD	80.8
13C-OCDD	80.5
13C-2,3,7,8-TCDF	75.9
13C-1,2,3,7,8-PECDF	77.9
13C-1,2,3,4,7,8-HXCDF	78.3
13C-1,2,3,4,6,7,8-HPCDF	81.5

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*P. Hargrove*

QA/QC Chemist

For Axyx Internal Use Only [ XSL Template: AXYS.xsl; Created: 21-Nov-2005 09:33:53; Application: XMLTransformer-1.5.4;  
Report Filename: AXYS\_DIOXINS\_AXYSDB5\_L8155-1\_SJ489394.html; Workgroup: WG17490; Design ID: 194 ]



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-003	<b>AXYS FILE:</b>	L8155-2
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	26-Oct-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	20-Sep-2005
<b>SAMPLE SIZE:</b>	10.3 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
		<b>ANALYSIS DATE:</b>	03-Oct-2005
<b>% Moisture:</b>	48.4	<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	11.0	0.0501		
1,2,3,7,8-PECDD	4.49	0.0710		
1,2,3,4,7,8-HXCDD	9.19	0.650		
1,2,3,6,7,8-HXCDD	24.6	0.650		
1,2,3,7,8,9-HXCDD	37.9	0.650		
1,2,3,4,6,7,8-HPCDD	736	0.410		
OCDD	10000	61.5		
2,3,7,8-TCDF *	5.40	0.0480		
1,2,3,7,8-PECDF	1.91	0.0680		
2,3,4,7,8-PECDF	1.89	0.0680		
1,2,3,4,7,8-HXCDF	3.57	0.0890		
1,2,3,6,7,8-HXCDF	4.82	0.0890		
2,3,4,6,7,8-HXCDF	1.92	0.0890		
1,2,3,7,8,9-HXCDF	0.443	0.0890		
1,2,3,4,6,7,8-HPCDF	30.3	0.190		
1,2,3,4,7,8,9-HPCDF	2.34	0.192		
OCDF	40.3	0.210		
TOTAL TETRA-DIOXINS	89.2	0.0501		
TOTAL PENTA-DIOXINS	121	0.0710		
TOTAL HEXA-DIOXINS	551	0.650		
TOTAL HEPTA-DIOXINS	1690	0.410		
TOTAL TETRA-FURANS	35.2	0.0902		
TOTAL PENTA-FURANS	37.7	0.0680		
TOTAL HEXA-FURANS	57.2	0.0890		
TOTAL HEPTA-FURANS	71.7	0.190		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	34.0
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	34.0

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	63.8
13C-1,2,3,7,8-PECDD	59.1
13C-1,2,3,6,7,8-HXCDD	61.4
13C-1,2,3,4,6,7,8-HPCDD	62.4
13C-OCDD	61.5
13C-2,3,7,8-TCDF	59.4
13C-1,2,3,7,8-PECDF	60.6
13C-1,2,3,4,7,8-HXCDF	63.0
13C-1,2,3,4,6,7,8-HPCDF	57.8

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

CLIENT SAMPLE I.D.:	05VN-007	AXYS FILE:	L7744-1 W
SAMPLE COLLECTION:	N/A	REPORT DATE:	11-Jun-2005
CLIENT NO.:	2607	METHOD NO.:	AXYS METHOD MLA-017 Rev 09
SAMPLE TYPE:	SEDIMENT	EXTRACTION DATE:	27-Apr-2005
SAMPLE SIZE:	8.23 g (dry)	INSTRUMENT:	HR GC/MS
		ANALYSIS DATE:	19-May-2005
% Moisture:	49.3	CONCENTRATION IN:	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	6.46	0.0610		
1,2,3,7,8-PECDD	1.24	0.0610		
1,2,3,4,7,8-HXCDD	1.72	0.112		
1,2,3,6,7,8-HXCDD	3.97	0.123		
1,2,3,7,8,9-HXCDD	5.30	0.116		
1,2,3,4,6,7,8-HPCDD	111	0.422		
OCDD	3130	3.79		
2,3,7,8-TCDF *	2.61	0.0608		
1,2,3,7,8-PECDF	0.974	0.0748		
2,3,4,7,8-PECDF	1.33	0.0790		
1,2,3,4,7,8-HXCDF	1.91	0.0610		
1,2,3,6,7,8-HXCDF	1.57	0.0610		
2,3,4,6,7,8-HXCDF	1.32	0.0610		
1,2,3,7,8,9-HXCDF	0.262	0.0688		
1,2,3,4,6,7,8-HPCDF	13.5	0.165		
1,2,3,4,7,8,9-HPCDF	1.20	0.213		
OCDF	23.5	0.0950		
TOTAL TETRA-DIOXINS	15.5	0.0610		
TOTAL PENTA-DIOXINS	16.6	0.0610		
TOTAL HEXA-DIOXINS	64.4	0.117		
TOTAL HEPTA-DIOXINS	256	0.0610		
TOTAL TETRA-FURANS	20.1	0.118		
TOTAL PENTA-FURANS	17.0	0.0768	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEXA-FURANS	22.7	0.0610	2,3,7,8-TCDD TEQs (ND=0) =	11.9
TOTAL HEPTA-FURANS	30.5	0.186	2,3,7,8-TCDD TEQs (ND=1/2 DL) =	11.9

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	84.3
13C-1,2,3,7,8-PECDD	85.7
13C-1,2,3,6,7,8-HXCDD	76.0
13C-1,2,3,4,6,7,8-HPCDD	77.1
13C-OCDD	76.5
13C-2,3,7,8-TCDF	83.8
13C-1,2,3,7,8-PECDF	84.2
13C-1,2,3,4,7,8-HXCDF	75.6
13C-1,2,3,4,6,7,8-HPCDF	73.3

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*B. Watson*

QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-008	<b>AXYS FILE:</b>	L7744-2
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	11-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	27-Apr-2005
<b>SAMPLE SIZE:</b>	10.4 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	18.8	<b>ANALYSIS DATE:</b>	11-May-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	0.175	0.0480		
1,2,3,7,8-PECDD	0.058	0.0480		
1,2,3,4,7,8-HXCDD	0.099	0.0480		
1,2,3,6,7,8-HXCDD	0.294	0.0480		
1,2,3,7,8,9-HXCDD	0.387	0.0480		
1,2,3,4,6,7,8-HPCDD	7.43	0.0480		
OCDD	167	0.185		
2,3,7,8-TCDF *	0.085	0.0482		
1,2,3,7,8-PECDF	0.055	0.0480		
2,3,4,7,8-PECDF	NDR (0.102)	0.0480		
1,2,3,4,7,8-HXCDF	0.111	0.0480		
1,2,3,6,7,8-HXCDF	0.079	0.0480		
2,3,4,6,7,8-HXCDF	0.064	0.0480		
1,2,3,7,8,9-HXCDF	ND	0.0480		
1,2,3,4,6,7,8-HPCDF	0.921	0.0480		
1,2,3,4,7,8,9-HPCDF	0.096	0.0480		
OCDF	1.74	0.0480		
TOTAL TETRA-DIOXINS	0.987	0.0480		
TOTAL PENTA-DIOXINS	1.11	0.0480		
TOTAL HEXA-DIOXINS	5.32	0.0480		
TOTAL HEPTA-DIOXINS	18.1	0.0480		
TOTAL TETRA-FURANS	0.577	0.0480		
TOTAL PENTA-FURANS	0.621	0.0480		
TOTAL HEXA-FURANS	1.37	0.0480		
TOTAL HEPTA-FURANS	2.28	0.0480		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	0.449
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	0.463

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	89.5
13C-1,2,3,7,8-PECDD	85.4
13C-1,2,3,6,7,8-HXCDD	85.2
13C-1,2,3,4,6,7,8-HPCDD	72.7
13C-OCDD	71.6
13C-2,3,7,8-TCDF	89.9
13C-1,2,3,7,8-PECDF	88.1
13C-1,2,3,4,7,8-HXCDF	98.4
13C-1,2,3,4,6,7,8-HPCDF	77.1

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*B. White*

QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-009	<b>AXYS FILE:</b>	L7744-3 W
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	11-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	27-Apr-2005
<b>SAMPLE SIZE:</b>	12.2 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	56.0	<b>ANALYSIS DATE:</b>	19-May-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	6.84	0.0453		
1,2,3,7,8-PECDD	1.64	0.0450		
1,2,3,4,7,8-HXCDD	2.20	0.220		
1,2,3,6,7,8-HXCDD	5.31	0.220		
1,2,3,7,8,9-HXCDD	6.89	0.220		
1,2,3,4,6,7,8-HPCDD	124	0.461		
OCDD	2610	36.4		
2,3,7,8-TCDF *	3.53	0.0411		
1,2,3,7,8-PECDF	1.34	0.0760		
2,3,4,7,8-PECDF	1.81	0.0760		
1,2,3,4,7,8-HXCDF	3.06	0.160		
1,2,3,6,7,8-HXCDF	2.12	0.160		
2,3,4,6,7,8-HXCDF	1.83	0.160		
1,2,3,7,8,9-HXCDF	0.394	0.160		
1,2,3,4,6,7,8-HPCDF	17.8	0.300		
1,2,3,4,7,8,9-HPCDF	1.99	0.300		
OCDF	26.6	0.571		
TOTAL TETRA-DIOXINS	18.4	0.0453		
TOTAL PENTA-DIOXINS	20.1	0.0450		
TOTAL HEXA-DIOXINS	72.7	0.220		
TOTAL HEPTA-DIOXINS	273	0.460		
TOTAL TETRA-FURANS	30.9	0.120		
TOTAL PENTA-FURANS	26.9	0.0760	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEXA-FURANS	30.6	0.160	2,3,7,8-TCDD TEQs (ND=0) =	13.7
TOTAL HEPTA-FURANS	38.3	0.300	2,3,7,8-TCDD TEQs (ND=1/2 DL) =	13.7

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	78.9
13C-1,2,3,7,8-PECDD	78.6
13C-1,2,3,6,7,8-HXCDD	68.5
13C-1,2,3,4,6,7,8-HPCDD	69.8
13C-OCDD	69.5
13C-2,3,7,8-TCDF	75.8
13C-1,2,3,7,8-PECDF	75.0
13C-1,2,3,4,7,8-HXCDF	74.2
13C-1,2,3,4,6,7,8-HPCDF	67.6

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: B. W. Baker QA/QC Chemist





**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-010	<b>AXYS FILE:</b>	L7744-4 W
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	11-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	27-Apr-2005
<b>SAMPLE SIZE:</b>	9.90 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	30.0	<b>ANALYSIS DATE:</b>	19-May-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	0.415	0.0540		
1,2,3,7,8-PECDD	0.437	0.0510		
1,2,3,4,7,8-HXCDD	0.565	0.0730		
1,2,3,6,7,8-HXCDD	1.23	0.0730		
1,2,3,7,8,9-HXCDD	1.62	0.0730		
1,2,3,4,6,7,8-HPCDD	27.0	0.320		
OCDD	486	0.870		
2,3,7,8-TCDF *	0.430	0.0505		
1,2,3,7,8-PECDF	0.600	0.0530		
2,3,4,7,8-PECDF	0.749	0.0538		
1,2,3,4,7,8-HXCDF	1.20	0.0510		
1,2,3,6,7,8-HXCDF	0.906	0.0510		
2,3,4,6,7,8-HXCDF	0.687	0.0510		
1,2,3,7,8,9-HXCDF	0.254	0.0510		
1,2,3,4,6,7,8-HPCDF	6.71	0.780		
1,2,3,4,7,8,9-HPCDF	0.905	0.782		
OCDF	8.80	0.144		
TOTAL TETRA-DIOXINS	3.20	0.0540		
TOTAL PENTA-DIOXINS	5.64	0.0510		
TOTAL HEXA-DIOXINS	17.9	0.0730		
TOTAL HEPTA-DIOXINS	59.4	0.320		
TOTAL TETRA-FURANS	8.27	0.0663		
TOTAL PENTA-FURANS	8.48	0.0530	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEXA-FURANS	8.89	0.0510	2,3,7,8-TCDD TEQs (ND=0) =	2.34
TOTAL HEPTA-FURANS	11.5	0.780	2,3,7,8-TCDD TEQs (ND=1/2 DL) =	2.34

**Surrogate Standards** **% Recovery**

13C-2,3,7,8-TCDD	81.8
13C-1,2,3,7,8-PECDD	84.9
13C-1,2,3,6,7,8-HXCDD	76.5
13C-1,2,3,4,6,7,8-HPCDD	76.7
13C-OCDD	69.6
13C-2,3,7,8-TCDF	81.1
13C-1,2,3,7,8-PECDF	81.4
13C-1,2,3,4,7,8-HXCDF	78.3
13C-1,2,3,4,6,7,8-HPCDF	73.0

1. SDL = Sample Detection Limit
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5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*B. W. K.*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-011  
**SAMPLE COLLECTION:** N/A  
**CLIENT NO.:** 2607

**SAMPLE TYPE:** SEDIMENT  
**SAMPLE SIZE:** 10.7 g (dry)

**% Moisture:** 37.8

**AXYS FILE:** L8155-3 (A)

**REPORT DATE:** 26-Oct-2005  
**METHOD NO.:** AXYS METHOD MLA-017 Rev 10  
**EXTRACTION DATE:** 20-Sep-2005  
**INSTRUMENT:** HR GC/MS  
**ANALYSIS DATE:** 03-Oct-2005  
**CONCENTRATION IN:** pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)
2,3,7,8-TCDD	1.61	0.0480
1,2,3,7,8-PECDD	1.34	0.0553
1,2,3,4,7,8-HXCDD	2.38	0.140
1,2,3,6,7,8-HXCDD	5.53	0.140
1,2,3,7,8,9-HXCDD	6.99	0.140
1,2,3,4,6,7,8-HPCDD	145	0.230
OCDD	2290	13.7
2,3,7,8-TCDF *	2.25	0.0470
1,2,3,7,8-PECDF	1.87	0.0510
2,3,4,7,8-PECDF	2.34	0.0510
1,2,3,4,7,8-HXCDF	2.77	0.0470
1,2,3,6,7,8-HXCDF	3.24	0.0470
2,3,4,6,7,8-HXCDF	2.44	0.0470
1,2,3,7,8,9-HXCDF	0.305	0.0470
1,2,3,4,6,7,8-HPCDF	19.0	0.0990
1,2,3,4,7,8,9-HPCDF	1.53	0.0994
OCDF	23.5	0.180
TOTAL TETRA-DIOXINS	16.4	0.0480
TOTAL PENTA-DIOXINS	23.9	0.0553
TOTAL HEXA-DIOXINS	92.0	0.140
TOTAL HEPTA-DIOXINS	352	0.230
TOTAL TETRA-FURANS	30.8	0.0980
TOTAL PENTA-FURANS	32.8	0.0510
TOTAL HEXA-FURANS	33.7	0.0470
TOTAL HEPTA-FURANS	37.2	0.0990

**2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)**

2,3,7,8-TCDD TEQs (ND=0) = 8.69  
2,3,7,8-TCDD TEQs (ND=1/2 DL) = 8.69

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	87.8
13C-1,2,3,7,8-PECDD	83.3
13C-1,2,3,6,7,8-HXCDD	86.4
13C-1,2,3,4,6,7,8-HPCDD	81.4
13C-OCDD	73.4
13C-2,3,7,8-TCDF	82.9
13C-1,2,3,7,8-PECDF	84.9
13C-1,2,3,4,7,8-HXCDF	87.4
13C-1,2,3,4,6,7,8-HPCDF	82.8

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*[Signature]*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-011 (Duplicate)	<b>AXYS FILE:</b>	WG16946-103 (DUP L8155-3)
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	26-Oct-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	20-Sep-2005
<b>SAMPLE SIZE:</b>	10.5 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
		<b>ANALYSIS DATE:</b>	03-Oct-2005
<b>% Moisture:</b>	38.3	<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	1.46	0.0480	
1,2,3,7,8-PECDD	1.34	0.0480	
1,2,3,4,7,8-HXCDD	2.08	0.140	
1,2,3,6,7,8-HXCDD	5.30	0.143	
1,2,3,7,8,9-HXCDD	7.14	0.140	
1,2,3,4,6,7,8-HPCDD	140	0.230	
OCDD	2270	14.3	
2,3,7,8-TCDF *	2.00	0.0480	
1,2,3,7,8-PECDF	1.99	0.0490	
2,3,4,7,8-PECDF	2.48	0.0490	
1,2,3,4,7,8-HXCDF	2.63	0.0480	
1,2,3,6,7,8-HXCDF	3.14	0.0480	
2,3,4,6,7,8-HXCDF	2.42	0.0480	
1,2,3,7,8,9-HXCDF	0.318	0.0480	
1,2,3,4,6,7,8-HPCDF	18.1	0.0890	
1,2,3,4,7,8,9-HPCDF	1.43	0.0890	
OCDF	22.4	0.110	
TOTAL TETRA-DIOXINS	15.7	0.0480	
TOTAL PENTA-DIOXINS	23.1	0.0480	
TOTAL HEXA-DIOXINS	92.7	0.140	
TOTAL HEPTA-DIOXINS	345	0.230	
TOTAL TETRA-FURANS	28.6	0.0810	
TOTAL PENTA-FURANS	32.8	0.0490	
TOTAL HEXA-FURANS	33.7	0.0480	
TOTAL HEPTA-FURANS	37.9	0.0890	
		<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
		2,3,7,8-TCDD TEQs (ND=0) =	8.47
		2,3,7,8-TCDD TEQs (ND=1/2 DL) =	8.47

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	91.3
13C-1,2,3,7,8-PECDD	92.6
13C-1,2,3,6,7,8-HXCDD	89.4
13C-1,2,3,4,6,7,8-HPCDD	87.7
13C-OCDD	82.1
13C-2,3,7,8-TCDF	87.1
13C-1,2,3,7,8-PECDF	89.4
13C-1,2,3,4,7,8-HXCDF	89.3
13C-1,2,3,4,6,7,8-HPCDF	81.7

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4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*[Signature]*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-012	<b>AXYS FILE:</b>	L8155-4 W
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	26-Oct-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	20-Sep-2005
<b>SAMPLE SIZE:</b>	10.2 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	70.1	<b>ANALYSIS DATE:</b>	12-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	22.6	0.225	
1,2,3,7,8-PECDD	20.4	0.225	
1,2,3,4,7,8-HXCDD	24.5	1.03	
1,2,3,6,7,8-HXCDD	81.6	1.03	
1,2,3,7,8,9-HXCDD	94.6	1.03	
1,2,3,4,6,7,8-HPCDD	2120	3.83	
OCDD	27400	24.0	
2,3,7,8-TCDF *	43.8	0.181	
1,2,3,7,8-PECDF	48.7	0.700	
2,3,4,7,8-PECDF	66.4	0.702	
1,2,3,4,7,8-HXCDF	69.0	0.730	
1,2,3,6,7,8-HXCDF	83.1	0.730	
2,3,4,6,7,8-HXCDF	66.7	0.730	
1,2,3,7,8,9-HXCDF	6.66	0.730	
1,2,3,4,6,7,8-HPCDF	401	1.05	
1,2,3,4,7,8,9-HPCDF	32.1	1.05	
OCDF	353	1.16	
TOTAL TETRA-DIOXINS	308	0.225	
TOTAL PENTA-DIOXINS	468	0.225	
TOTAL HEXA-DIOXINS	1410	1.03	
TOTAL HEPTA-DIOXINS	5220	3.83	
TOTAL TETRA-FURANS	852	4.63	
TOTAL PENTA-FURANS	853	0.700	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)
TOTAL HEXA-FURANS	833	0.730	2,3,7,8-TCDD TEQs (ND=0) = 154
TOTAL HEPTA-FURANS	754	1.05	2,3,7,8-TCDD TEQs (ND=1/2 DL) = 154

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	57.4
13C-1,2,3,7,8-PECDD	57.6
13C-1,2,3,6,7,8-HXCDD	56.0
13C-1,2,3,4,6,7,8-HPCDD	54.0
13C-OCDD	52.2
13C-2,3,7,8-TCDF	57.2
13C-1,2,3,7,8-PECDF	57.0
13C-1,2,3,4,7,8-HXCDF	55.8
13C-1,2,3,4,6,7,8-HPCDF	52.9

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5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*[Signature]*

QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-013	<b>AXYS FILE:</b>	L8155-5 W
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	26-Oct-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	20-Sep-2005
<b>SAMPLE SIZE:</b>	10.2 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	62.3	<b>ANALYSIS DATE:</b>	12-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	2.28	0.252	
1,2,3,7,8-PECDD	6.51	0.304	
1,2,3,4,7,8-HxCDD	7.94	1.12	
1,2,3,6,7,8-HxCDD	20.4	1.12	
1,2,3,7,8,9-HxCDD	60.7	1.12	
1,2,3,4,6,7,8-HPCDD	895	2.46	
OCDD	31700	21.6	
2,3,7,8-TCDF *	3.41	0.0490	
1,2,3,7,8-PECDF	2.36	0.340	
2,3,4,7,8-PECDF	3.28	0.340	
1,2,3,4,7,8-HxCDF	5.06	0.390	
1,2,3,6,7,8-HxCDF	4.13	0.390	
2,3,4,6,7,8-HxCDF	3.10	0.390	
1,2,3,7,8,9-HxCDF	0.535	0.390	
1,2,3,4,6,7,8-HPCDF	36.8	0.780	
1,2,3,4,7,8,9-HPCDF	3.05	0.780	
OCDF	78.4	1.06	
TOTAL TETRA-DIOXINS	709	0.252	
TOTAL PENTA-DIOXINS	533	0.304	
TOTAL HEXA-DIOXINS	1940	1.12	
TOTAL HEPTA-DIOXINS	3420	2.46	
TOTAL TETRA-FURANS	49.3	0.402	
TOTAL PENTA-FURANS	43.6	0.351	
TOTAL HEXA-FURANS	68.0	0.390	
TOTAL HEPTA-FURANS	87.1	0.780	
		<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
		2,3,7,8-TCDD TEQs (ND=0) =	33.6
		2,3,7,8-TCDD TEQs (ND=1/2 DL) =	33.6

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	73.5
13C-1,2,3,7,8-PECDD	75.6
13C-1,2,3,6,7,8-HxCDD	78.7
13C-1,2,3,4,6,7,8-HPCDD	73.5
13C-OCDD	78.1
13C-2,3,7,8-TCDF	76.3
13C-1,2,3,7,8-PECDF	74.5
13C-1,2,3,4,7,8-HxCDF	73.8
13C-1,2,3,4,6,7,8-HPCDF	76.0

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5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*[Signature]*

QA/QC Chemist





**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-015	<b>AXYS FILE:</b>	L8155-6
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	26-Oct-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	20-Sep-2005
<b>SAMPLE SIZE:</b>	10.5 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
		<b>ANALYSIS DATE:</b>	04-Oct-2005
<b>% Moisture:</b>	40.1	<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	11.7	0.0480		
1,2,3,7,8-PECDD	2.60	0.0480		
1,2,3,4,7,8-HXCDD	6.50	0.150		
1,2,3,6,7,8-HXCDD	15.7	0.150		
1,2,3,7,8,9-HXCDD	42.4	0.150		
1,2,3,4,6,7,8-HPCDD	686	0.302		
OCDD	17000	2.83		
2,3,7,8-TCDF *	0.710	0.0480		
1,2,3,7,8-PECDF	0.410	0.130		
2,3,4,7,8-PECDF	0.429	0.130		
1,2,3,4,7,8-HXCDF	0.851	0.0650		
1,2,3,6,7,8-HXCDF	0.585	0.0650		
2,3,4,6,7,8-HXCDF	0.517	0.0650		
1,2,3,7,8,9-HXCDF	0.122	0.0650		
1,2,3,4,6,7,8-HPCDF	4.55	0.130		
1,2,3,4,7,8,9-HPCDF	0.400	0.132		
OCDF	9.82	1.21		
TOTAL TETRA-DIOXINS	182	0.0480		
TOTAL PENTA-DIOXINS	170	0.0480		
TOTAL HEXA-DIOXINS	703	0.150		
TOTAL HEPTA-DIOXINS	1800	0.302		
TOTAL TETRA-FURANS	15.7	0.0670		
TOTAL PENTA-FURANS	6.76	0.130		
TOTAL HEXA-FURANS	7.90	0.0650		
TOTAL HEPTA-FURANS	8.97	0.130		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	29.9
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	29.9

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	61.2
13C-1,2,3,7,8-PECDD	60.5
13C-1,2,3,6,7,8-HXCDD	63.4
13C-1,2,3,4,6,7,8-HPCDD	67.5
13C-OCDD	69.2
13C-2,3,7,8-TCDF	58.0
13C-1,2,3,7,8-PECDF	62.0
13C-1,2,3,4,7,8-HXCDF	64.1
13C-1,2,3,4,6,7,8-HPCDF	60.8

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5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*[Signature]*

QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-016	<b>AXYS FILE:</b>	L7744-5
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	11-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	27-Apr-2005
<b>SAMPLE SIZE:</b>	11.2 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	28.2	<b>ANALYSIS DATE:</b>	11-May-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	3.23	0.0450		
1,2,3,7,8-PECDD	1.12	0.0450		
1,2,3,4,7,8-HXCDD	3.38	0.320		
1,2,3,6,7,8-HXCDD	19.2	0.320		
1,2,3,7,8,9-HXCDD	105	0.320		
1,2,3,4,6,7,8-HPCDD	1310	0.671		
OCDD	24700	12.4		
2,3,7,8-TCDF *	0.227	0.0448		
1,2,3,7,8-PECDF	0.135	0.0450		
2,3,4,7,8-PECDF	0.226	0.0450		
1,2,3,4,7,8-HXCDF	0.321	0.0450		
1,2,3,6,7,8-HXCDF	0.198	0.0450		
2,3,4,6,7,8-HXCDF	0.200	0.0450		
1,2,3,7,8,9-HXCDF	ND	0.0450		
1,2,3,4,6,7,8-HPCDF	1.47	0.0450		
1,2,3,4,7,8,9-HPCDF	0.127	0.0450		
OCDF	2.75	0.0549		
TOTAL TETRA-DIOXINS	103	0.0450		
TOTAL PENTA-DIOXINS	194	0.0450		
TOTAL HEXA-DIOXINS	785	0.320		
TOTAL HEPTA-DIOXINS	2620	0.670		
TOTAL TETRA-FURANS	3.46	0.0450		
TOTAL PENTA-FURANS	2.33	0.0450		
TOTAL HEXA-FURANS	2.55	0.0450		
TOTAL HEPTA-FURANS	3.07	0.0450		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	32.9
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	32.9

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	60.4
13C-1,2,3,7,8-PECDD	60.7
13C-1,2,3,6,7,8-HXCDD	59.4
13C-1,2,3,4,6,7,8-HPCDD	56.7
13C-OCDD	66.9
13C-2,3,7,8-TCDF	60.3
13C-1,2,3,7,8-PECDF	63.0
13C-1,2,3,4,7,8-HXCDF	61.4
13C-1,2,3,4,6,7,8-HPCDF	55.4

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5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*B. Waters*

QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-017	<b>AXYS FILE:</b>	L7744-6 W
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	11-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	27-Apr-2005
<b>SAMPLE SIZE:</b>	10.5 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	49.2	<b>ANALYSIS DATE:</b>	19-May-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	9.06	0.0610		
1,2,3,7,8-PECDD	3.89	0.0480		
1,2,3,4,7,8-HXCDD	4.77	0.210		
1,2,3,6,7,8-HXCDD	14.0	0.214		
1,2,3,7,8,9-HXCDD	15.2	0.210		
1,2,3,4,6,7,8-HPCDD	305	0.230		
OCDD	3190	1.57		
2,3,7,8-TCDF *	4.67	0.0477		
1,2,3,7,8-PECDF	3.31	0.140		
2,3,4,7,8-PECDF	4.07	0.141		
1,2,3,4,7,8-HXCDF	7.31	0.220		
1,2,3,6,7,8-HXCDF	6.10	0.220		
2,3,4,6,7,8-HXCDF	4.45	0.220		
1,2,3,7,8,9-HXCDF	0.700	0.220		
1,2,3,4,6,7,8-HPCDF	45.3	0.120		
1,2,3,4,7,8,9-HPCDF	3.81	0.120		
OCDF	57.5	0.477		
TOTAL TETRA-DIOXINS	29.8	0.0610		
TOTAL PENTA-DIOXINS	44.5	0.0480		
TOTAL HEXA-DIOXINS	144	0.210		
TOTAL HEPTA-DIOXINS	620	0.230		
TOTAL TETRA-FURANS	54.5	0.560		
TOTAL PENTA-FURANS	61.3	0.140		
TOTAL HEXA-FURANS	81.6	0.220		
TOTAL HEPTA-FURANS	99.2	0.120		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	24.7
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	24.7

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	84.1
13C-1,2,3,7,8-PECDD	90.5
13C-1,2,3,6,7,8-HXCDD	78.5
13C-1,2,3,4,6,7,8-HPCDD	79.7
13C-OCDD	77.0
13C-2,3,7,8-TCDF	83.2
13C-1,2,3,7,8-PECDF	85.3
13C-1,2,3,4,7,8-HXCDF	75.7
13C-1,2,3,4,6,7,8-HPCDF	75.6

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*B. W. K.*

QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-018	<b>AXYS FILE:</b>	L8155-7
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	26-Oct-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	20-Sep-2005
<b>SAMPLE SIZE:</b>	10.4 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	59.5	<b>ANALYSIS DATE:</b>	04-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	227	0.0480	
1,2,3,7,8-PECDD	11.4	0.0610	
1,2,3,4,7,8-HXCDD	11.7	0.0970	
1,2,3,6,7,8-HXCDD	29.8	0.0973	
1,2,3,7,8,9-HXCDD	31.4	0.0970	
1,2,3,4,6,7,8-HPCDD	639	0.453	
OCDD	8490	4.78	
2,3,7,8-TCDF *	100	0.0480	
1,2,3,7,8-PECDF	4.33	0.0660	
2,3,4,7,8-PECDF	5.19	0.0660	
1,2,3,4,7,8-HXCDF	7.69	0.0810	
1,2,3,6,7,8-HXCDF	7.37	0.0810	
2,3,4,6,7,8-HXCDF	5.22	0.0810	
1,2,3,7,8,9-HXCDF	0.785	0.0811	
1,2,3,4,6,7,8-HPCDF	71.3	0.170	
1,2,3,4,7,8,9-HPCDF	4.66	0.170	
OCDF	95.0	0.761	
TOTAL TETRA-DIOXINS	273	0.0480	
TOTAL PENTA-DIOXINS	112	0.0610	
TOTAL HEXA-DIOXINS	333	0.0970	
TOTAL HEPTA-DIOXINS	1350	0.453	
TOTAL TETRA-FURANS	220	0.294	
TOTAL PENTA-FURANS	148	0.0660	
TOTAL HEXA-FURANS	119	0.0810	
TOTAL HEPTA-FURANS	155	0.170	
		<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
		2,3,7,8-TCDD TEQs (ND=0) =	269
		2,3,7,8-TCDD TEQs (ND=1/2 DL) =	269

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	87.1
13C-1,2,3,7,8-PECDD	81.3
13C-1,2,3,6,7,8-HXCDD	79.2
13C-1,2,3,4,6,7,8-HPCDD	85.9
13C-OCDD	85.4
13C-2,3,7,8-TCDF	83.5
13C-1,2,3,7,8-PECDF	82.3
13C-1,2,3,4,7,8-HXCDF	88.4
13C-1,2,3,4,6,7,8-HPCDF	79.7

1. SDL = Sample Detection Limit
2. ND = Not detected
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4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*[Signature]*

QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-021	<b>AXYS FILE:</b>	L7744-7 W
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	11-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	27-Apr-2005
<b>SAMPLE SIZE:</b>	10.7 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	36.6	<b>ANALYSIS DATE:</b>	19-May-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	10.8	0.0630	
1,2,3,7,8-PECDD	1.20	0.0690	
1,2,3,4,7,8-HXCDD	1.76	0.260	
1,2,3,6,7,8-HXCDD	5.45	0.260	
1,2,3,7,8,9-HXCDD	5.95	0.260	
1,2,3,4,6,7,8-HPCDD	150	0.390	
OCDD	3040	3.15	
2,3,7,8-TCDF *	0.877	0.0466	
1,2,3,7,8-PECDF	0.755	0.0700	
2,3,4,7,8-PECDF	1.24	0.0700	
1,2,3,4,7,8-HXCDF	1.76	0.120	
1,2,3,6,7,8-HXCDF	1.29	0.120	
2,3,4,6,7,8-HXCDF	1.03	0.120	
1,2,3,7,8,9-HXCDF	0.172	0.120	
1,2,3,4,6,7,8-HPCDF	13.4	0.180	
1,2,3,4,7,8,9-HPCDF	0.955	0.180	
OCDF	27.2	0.466	
TOTAL TETRA-DIOXINS	17.9	0.0630	
TOTAL PENTA-DIOXINS	13.4	0.0690	
TOTAL HEXA-DIOXINS	63.7	0.260	
TOTAL HEPTA-DIOXINS	303	0.390	
TOTAL TETRA-FURANS	13.3	0.0792	
TOTAL PENTA-FURANS	15.7	0.0700	
TOTAL HEXA-FURANS	21.0	0.120	
TOTAL HEPTA-FURANS	33.8	0.180	
		<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
		2,3,7,8-TCDD TEQs (ND=0) =	16.4
		2,3,7,8-TCDD TEQs (ND=1/2 DL) =	16.4

**Surrogate Standards** **% Recovery**

13C-2,3,7,8-TCDD	80.0
13C-1,2,3,7,8-PECDD	88.3
13C-1,2,3,6,7,8-HXCDD	76.7
13C-1,2,3,4,6,7,8-HPCDD	75.2
13C-OCDD	68.9
13C-2,3,7,8-TCDF	80.7
13C-1,2,3,7,8-PECDF	84.9
13C-1,2,3,4,7,8-HXCDF	75.0
13C-1,2,3,4,6,7,8-HPCDF	72.1

1. SDL = Sample Detection Limit
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4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: B. W. Baker QA/QC Chemist





**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-022	<b>AXYS FILE:</b>	L7744-8 W
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	11-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	27-Apr-2005
<b>SAMPLE SIZE:</b>	3.57 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	77.8	<b>ANALYSIS DATE:</b>	19-May-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	130	0.440	
1,2,3,7,8-PECDD	11.0	0.240	
1,2,3,4,7,8-HXCDD	17.6	1.92	
1,2,3,6,7,8-HXCDD	49.7	1.92	
1,2,3,7,8,9-HXCDD	63.2	1.92	
1,2,3,4,6,7,8-HPCDD	1560	1.64	
OCDD	42100	15.0	
2,3,7,8-TCDF *	29.8	0.140	
1,2,3,7,8-PECDF	13.3	0.530	
2,3,4,7,8-PECDF	12.8	0.530	
1,2,3,4,7,8-HXCDF	17.6	1.17	
1,2,3,6,7,8-HXCDF	22.5	1.17	
2,3,4,6,7,8-HXCDF	8.55	1.17	
1,2,3,7,8,9-HXCDF	2.65	1.17	
1,2,3,4,6,7,8-HPCDF	137	1.03	
1,2,3,4,7,8,9-HPCDF	10.9	1.03	
OCDF	203	1.40	
TOTAL TETRA-DIOXINS	187	0.440	
TOTAL PENTA-DIOXINS	125	0.244	
TOTAL HEXA-DIOXINS	660	1.92	
TOTAL HEPTA-DIOXINS	3550	1.64	
TOTAL TETRA-FURANS	204	0.685	
TOTAL PENTA-FURANS	212	0.530	
TOTAL HEXA-FURANS	277	1.17	
TOTAL HEPTA-FURANS	340	1.03	
		<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
		2,3,7,8-TCDD TEQs (ND=0) =	191
		2,3,7,8-TCDD TEQs (ND=1/2 DL) =	191

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	79.2
13C-1,2,3,7,8-PECDD	83.8
13C-1,2,3,6,7,8-HXCDD	77.6
13C-1,2,3,4,6,7,8-HPCDD	75.9
13C-OCDD	72.9
13C-2,3,7,8-TCDF	78.8
13C-1,2,3,7,8-PECDF	81.1
13C-1,2,3,4,7,8-HXCDF	73.5
13C-1,2,3,4,6,7,8-HPCDF	70.1

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4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*B. White*

QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2218, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

CLIENT SAMPLE I.D.:	05VN-028	AXYS FILE:	L8155-8 R2
SAMPLE COLLECTION:	N/A		
CLIENT NO.:	2607	REPORT DATE:	21-Nov-2005
		METHOD NO.:	AXYS METHOD MLA-017 Rev 11
SAMPLE TYPE:	SEDIMENT	EXTRACTION DATE:	10-Nov-2005
SAMPLE SIZE:	10.5 g (dry)	INSTRUMENT:	HR GC/MS
		ANALYSIS DATE:	20-Nov-2005
% Moisture:	32.5	CONCENTRATION IN:	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	1.64	0.0480		
1,2,3,7,8-PECDD	8.94	0.0480		
1,2,3,4,7,8-HXCDD	9.52	0.150		
1,2,3,6,7,8-HXCDD	17.2	0.155		
1,2,3,7,8,9-HXCDD	27.4	0.150		
1,2,3,4,6,7,8-HPCDD	197	0.118		
OCDD	1030	0.126		
2,3,7,8-TCDF *	1.49	0.0480		
1,2,3,7,8-PECDF	1.49	0.0600		
2,3,4,7,8-PECDF	2.06	0.0600		
1,2,3,4,7,8-HXCDF	2.82	0.0770		
1,2,3,6,7,8-HXCDF	2.33	0.0770		
2,3,4,6,7,8-HXCDF	1.44	0.0770		
1,2,3,7,8,9-HXCDF	0.407	0.0770		
1,2,3,4,6,7,8-HPCDF	13.2	0.0480		
1,2,3,4,7,8,9-HPCDF	2.14	0.0480		
OCDF	111	0.0480		
TOTAL TETRA-DIOXINS	25.6	0.0480		
TOTAL PENTA-DIOXINS	81.4	0.0480		
TOTAL HEXA-DIOXINS	198	0.150		
TOTAL HEPTA-DIOXINS	440	0.118		
TOTAL TETRA-FURANS	25.4	0.195		
TOTAL PENTA-FURANS	27.7	0.0600	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEXA-FURANS	31.2	0.0770	2,3,7,8-TCDD TEQs (ND=0) =	20.2
TOTAL HEPTA-FURANS	31.0	0.0480	2,3,7,8-TCDD TEQs (ND=1/2 DL) =	20.2

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	70.1
13C-1,2,3,7,8-PECDD	70.7
13C-1,2,3,6,7,8-HXCDD	70.3
13C-1,2,3,4,6,7,8-HPCDD	77.1
13C-OCDD	77.1
13C-2,3,7,8-TCDF	69.8
13C-1,2,3,7,8-PECDF	71.5
13C-1,2,3,4,7,8-HXCDF	74.1
13C-1,2,3,4,6,7,8-HPCDF	78.4

1. SDL = Sample Detection Limit
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3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist

For Axis Internal Use Only [ XSL Template: AXYS.xsl; Created: 21-Nov-2005 09:33:53; Application: XMLTransformer-1.5.4;  
Report Filename: AXYS\_DIOXINS\_AXYSDB5\_L8155-8\_SJ489395.html; Workgroup: WG17490; Design ID: 194 ]



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b> 05VN-027	<b>AXYS FILE:</b> L7744-9 i (A)
<b>SAMPLE COLLECTION:</b> N/A	
<b>CLIENT NO.:</b> 2607	<b>REPORT DATE:</b> 11-Jun-2005
	<b>METHOD NO.:</b> AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b> SEDIMENT	<b>EXTRACTION DATE:</b> 27-Apr-2005
<b>SAMPLE SIZE:</b> 10.7 g (dry)	<b>INSTRUMENT:</b> HR GC/MS
	<b>ANALYSIS DATE:</b> 11-May-2005
<b>% Moisture:</b> 19.7	<b>CONCENTRATION IN:</b> pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	NDR (0.070)	0.0470		
1,2,3,7,8-PECDD	0.123	0.0470		
1,2,3,4,7,8-HXCDD	0.167	0.0470		
1,2,3,6,7,8-HXCDD	0.403	0.0470		
1,2,3,7,8,9-HXCDD	0.479	0.0470		
1,2,3,4,6,7,8-HPCDD	7.91	0.0470		
OCDD	61.2	0.0695		
2,3,7,8-TCDF *	0.081	0.0468		
1,2,3,7,8-PECDF	0.063	0.0470		
2,3,4,7,8-PECDF	0.096	0.0470		
1,2,3,4,7,8-HXCDF	0.137	0.0470		
1,2,3,6,7,8-HXCDF	0.091	0.0470		
2,3,4,6,7,8-HXCDF	0.089	0.0470		
1,2,3,7,8,9-HXCDF	ND	0.0470		
1,2,3,4,6,7,8-HPCDF	0.921	0.0470		
1,2,3,4,7,8,9-HPCDF	NDR (0.065)	0.0470		
OCDF	1.24	0.0470		
TOTAL TETRA-DIOXINS	0.374	0.0470		
TOTAL PENTA-DIOXINS	1.19	0.0470		
TOTAL HEXA-DIOXINS	5.60	0.0470		
TOTAL HEPTA-DIOXINS	20.1	0.0470		
TOTAL TETRA-FURANS	0.759	0.0470		
TOTAL PENTA-FURANS	0.938	0.0470		
TOTAL HEXA-FURANS	1.31	0.0470		
TOTAL HEPTA-FURANS	1.74	0.0470		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	0.413
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	0.439

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	53.9
13C-1,2,3,7,8-PECDD	53.9
13C-1,2,3,6,7,8-HXCDD	54.9
13C-1,2,3,4,6,7,8-HPCDD	48.3
13C-OCDD	44.7
13C-2,3,7,8-TCDF	53.2
13C-1,2,3,7,8-PECDF	55.2
13C-1,2,3,4,7,8-HXCDF	61.4
13C-1,2,3,4,6,7,8-HPCDF	49.3

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*B. White*

QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-027 (Duplicate)	<b>AXYS FILE:</b>	WG15626-103 i (DUP L7744-9)
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	11-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	27-Apr-2005
<b>SAMPLE SIZE:</b>	11.8 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	12.6	<b>ANALYSIS DATE:</b>	11-May-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	NDR (0.065)	0.0430		
1,2,3,7,8-PECDD	0.117	0.0430		
1,2,3,4,7,8-HXCDD	0.172	0.0430		
1,2,3,6,7,8-HXCDD	0.366	0.0430		
1,2,3,7,8,9-HXCDD	0.437	0.0430		
1,2,3,4,6,7,8-HPCDD	7.75	0.0430		
OCDD	59.9	0.0967		
2,3,7,8-TCDF *	0.073	0.0426		
1,2,3,7,8-PECDF	0.067	0.0430		
2,3,4,7,8-PECDF	0.098	0.0430		
1,2,3,4,7,8-HXCDF	0.110	0.0430		
1,2,3,6,7,8-HXCDF	0.081	0.0430		
2,3,4,6,7,8-HXCDF	0.083	0.0430		
1,2,3,7,8,9-HXCDF	ND	0.0430		
1,2,3,4,6,7,8-HPCDF	0.862	0.0430		
1,2,3,4,7,8,9-HPCDF	0.052	0.0430		
OCDF	1.33	0.0430		
TOTAL TETRA-DIOXINS	0.351	0.0430		
TOTAL PENTA-DIOXINS	1.00	0.0430		
TOTAL HEXA-DIOXINS	5.38	0.0430		
TOTAL HEPTA-DIOXINS	20.0	0.0430		
TOTAL TETRA-FURANS	0.694	0.0430		
TOTAL PENTA-FURANS	0.792	0.0430		
TOTAL HEXA-FURANS	1.26	0.0430		
TOTAL HEPTA-FURANS	1.65	0.0430		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	0.394
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	0.418

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	67.5
13C-1,2,3,7,8-PECDD	67.1
13C-1,2,3,6,7,8-HXCDD	69.0
13C-1,2,3,4,6,7,8-HPCDD	58.5
13C-OCDD	53.7
13C-2,3,7,8-TCDF	68.3
13C-1,2,3,7,8-PECDF	68.5
13C-1,2,3,4,7,8-HXCDF	78.4
13C-1,2,3,4,6,7,8-HPCDF	61.5

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*Bubba*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-028	<b>AXYS FILE:</b>	L7744-10 i
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	11-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	27-Apr-2005
<b>SAMPLE SIZE:</b>	9.38 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	51.0	<b>ANALYSIS DATE:</b>	14-May-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	0.262	0.0530		
1,2,3,7,8-PECDD	0.346	0.0530		
1,2,3,4,7,8-HXCDD	NDR (0.473)	0.0530		
1,2,3,6,7,8-HXCDD	1.03	0.0530		
1,2,3,7,8,9-HXCDD	1.23	0.0530		
1,2,3,4,6,7,8-HPCDD	17.9	0.0530		
OCDD	160	0.0530		
2,3,7,8-TCDF *	0.277	0.0533		
1,2,3,7,8-PECDF	0.301	0.0530		
2,3,4,7,8-PECDF	0.422	0.0530		
1,2,3,4,7,8-HXCDF	0.562	0.0530		
1,2,3,6,7,8-HXCDF	0.431	0.0530		
2,3,4,6,7,8-HXCDF	NDR (0.360)	0.0530		
1,2,3,7,8,9-HXCDF	0.100	0.0530		
1,2,3,4,6,7,8-HPCDF	2.73	0.0530		
1,2,3,4,7,8,9-HPCDF	NDR (0.252)	0.0530		
OCDF	3.21	0.0530		
TOTAL TETRA-DIOXINS	1.73	0.0530		
TOTAL PENTA-DIOXINS	3.24	0.0530		
TOTAL HEXA-DIOXINS	13.9	0.0530		
TOTAL HEPTA-DIOXINS	41.7	0.0530		
TOTAL TETRA-FURANS	5.13	0.0530		
TOTAL PENTA-FURANS	5.33	0.0530		
TOTAL HEXA-FURANS	5.22	0.0530		
TOTAL HEPTA-FURANS	4.73	0.0530		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	1.42
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	1.43

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	77.5
13C-1,2,3,7,8-PECDD	75.7
13C-1,2,3,6,7,8-HXCDD	86.1
13C-1,2,3,4,6,7,8-HPCDD	77.0
13C-OCDD	72.0
13C-2,3,7,8-TCDF	82.3
13C-1,2,3,7,8-PECDF	75.0
13C-1,2,3,4,7,8-HXCDF	88.1
13C-1,2,3,4,6,7,8-HPCDF	76.3

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*B. W. White*

QA/QC Chemist





**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-029	<b>AXYS FILE:</b>	L7744-11 i
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	11-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	27-Apr-2005
<b>SAMPLE SIZE:</b>	10.8 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
		<b>ANALYSIS DATE:</b>	14-May-2005
<b>% Moisture:</b>	26.5	<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	5.14	0.0460		
1,2,3,7,8-PECDD	1.31	0.0460		
1,2,3,4,7,8-HXCDD	1.72	0.0460		
1,2,3,6,7,8-HXCDD	4.59	0.0460		
1,2,3,7,8,9-HXCDD	4.82	0.0460		
1,2,3,4,6,7,8-HPCDD	149	0.113		
OCDD	3650	0.232		
2,3,7,8-TCDF *	0.986	0.0464		
1,2,3,7,8-PECDF	0.661	0.0460		
2,3,4,7,8-PECDF	0.952	0.0460		
1,2,3,4,7,8-HXCDF	1.36	0.0460		
1,2,3,6,7,8-HXCDF	1.09	0.0460		
2,3,4,6,7,8-HXCDF	0.786	0.0460		
1,2,3,7,8,9-HXCDF	0.153	0.0460		
1,2,3,4,6,7,8-HPCDF	9.90	0.0460		
1,2,3,4,7,8,9-HPCDF	0.940	0.0460		
OCDF	19.2	0.0460		
TOTAL TETRA-DIOXINS	10.6	0.0460		
TOTAL PENTA-DIOXINS	12.2	0.0460		
TOTAL HEXA-DIOXINS	49.4	0.0460		
TOTAL HEPTA-DIOXINS	310	0.110		
TOTAL TETRA-FURANS	13.8	0.0460		
TOTAL PENTA-FURANS	14.4	0.0460		
TOTAL HEXA-FURANS	19.5	0.0460		
TOTAL HEPTA-FURANS	26.6	0.0460		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	10.5
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	10.5

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	83.7
13C-1,2,3,7,8-PECDD	80.9
13C-1,2,3,6,7,8-HXCDD	82.1
13C-1,2,3,4,6,7,8-HPCDD	76.8
13C-OCDD	87.6
13C-2,3,7,8-TCDF	86.1
13C-1,2,3,7,8-PECDF	81.3
13C-1,2,3,4,7,8-HXCDF	83.7
13C-1,2,3,4,6,7,8-HPCDF	79.6

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved:                     *B. W. Baker*                     QA/QC Chemist



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## **Appendix A4.2**

### **Dioxin Data: Pleiku**

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**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-030

**SAMPLE COLLECTION:** N/A

**CLIENT NO.:** 2607

**SAMPLE TYPE:** SEDIMENT

**SAMPLE SIZE:** 11.8 g (dry)

**% Moisture:** 50.4

**AXYS FILE:** L7744-12

**REPORT DATE:** 11-Jun-2005

**METHOD NO.:** AXYS METHOD MLA-017 Rev 09

**EXTRACTION DATE:** 27-Apr-2005

**INSTRUMENT:** HR GC/MS

**ANALYSIS DATE:** 14-May-2005

**CONCENTRATION IN:** pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	1.18	0.0420		
1,2,3,7,8-PECDD	0.355	0.0420		
1,2,3,4,7,8-HXCDD	0.425	0.0560		
1,2,3,6,7,8-HXCDD	1.42	0.0560		
1,2,3,7,8,9-HXCDD	1.96	0.0560		
1,2,3,4,6,7,8-HPCDD	32.5	0.0720		
OCDD	278	0.0572		
2,3,7,8-TCDF *	0.316	0.0423		
1,2,3,7,8-PECDF	0.430	0.0420		
2,3,4,7,8-PECDF	0.471	0.0420		
1,2,3,4,7,8-HXCDF	0.935	0.0420		
1,2,3,6,7,8-HXCDF	0.764	0.0420		
2,3,4,6,7,8-HXCDF	0.487	0.0420		
1,2,3,7,8,9-HXCDF	0.295	0.0420		
1,2,3,4,6,7,8-HPCDF	9.79	0.0420		
1,2,3,4,7,8,9-HPCDF	0.716	0.0420		
OCDF	28.2	0.0420		
TOTAL TETRA-DIOXINS	3.67	0.0420		
TOTAL PENTA-DIOXINS	2.50	0.0420		
TOTAL HEXA-DIOXINS	13.3	0.0560		
TOTAL HEPTA-DIOXINS	65.6	0.0720		
TOTAL TETRA-FURANS	8.92	0.0420		
TOTAL PENTA-FURANS	7.51	0.0420	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEXA-FURANS	13.2	0.0420	2,3,7,8-TCDD TEQs (ND=0) =	2.91
TOTAL HEPTA-FURANS	27.3	0.0420	2,3,7,8-TCDD TEQs (ND=1/2 DL) =	2.91

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	75.8
13C-1,2,3,7,8-PECDD	73.9
13C-1,2,3,6,7,8-HXCDD	81.3
13C-1,2,3,4,6,7,8-HPCDD	77.4
13C-OCDD	66.7
13C-2,3,7,8-TCDF	79.1
13C-1,2,3,7,8-PECDF	74.0
13C-1,2,3,4,7,8-HXCDF	82.8
13C-1,2,3,4,6,7,8-HPCDF	81.3

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*Blakely*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

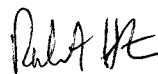
<b>CLIENT SAMPLE I.D.:</b>	05VN-031	<b>AXYS FILE:</b>	L8155-9 R
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	03-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	21-Oct-2005
<b>SAMPLE SIZE:</b>	10.7 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
		<b>ANALYSIS DATE:</b>	29-Oct-2005
<b>% Moisture:</b>	46.5	<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	0.623	0.0470		
1,2,3,7,8-PECDD	0.379	0.0470		
1,2,3,4,7,8-HXCDD	0.376	0.0470		
1,2,3,6,7,8-HXCDD	1.20	0.0470		
1,2,3,7,8,9-HXCDD	2.01	0.0470		
1,2,3,4,6,7,8-HPCDD	26.0	0.0584		
OCDD	228	0.0845		
2,3,7,8-TCDF *	0.394	0.0470		
1,2,3,7,8-PECDF	0.391	0.0470		
2,3,4,7,8-PECDF	0.468	0.0470		
1,2,3,4,7,8-HXCDF	0.898	0.0470		
1,2,3,6,7,8-HXCDF	0.617	0.0470		
2,3,4,6,7,8-HXCDF	0.485	0.0470		
1,2,3,7,8,9-HXCDF	0.328	0.0470		
1,2,3,4,6,7,8-HPCDF	7.85	0.0470		
1,2,3,4,7,8,9-HPCDF	NDR (0.584)	0.0470		
OCDF	20.3	0.0470		
TOTAL TETRA-DIOXINS	2.97	0.0470		
TOTAL PENTA-DIOXINS	2.92	0.0470		
TOTAL HEXA-DIOXINS	11.4	0.0470		
TOTAL HEPTA-DIOXINS	51.9	0.0584		
TOTAL TETRA-FURANS	8.70	0.0594		
TOTAL PENTA-FURANS	6.58	0.0470	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEXA-FURANS	10.1	0.0470	2,3,7,8-TCDD TEQs (ND=0) =	2.25
TOTAL HEPTA-FURANS	19.8	0.0470	2,3,7,8-TCDD TEQs (ND=1/2 DL) =	2.25

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	56.7
13C-1,2,3,7,8-PECDD	60.3
13C-1,2,3,6,7,8-HXCDD	59.9
13C-1,2,3,4,6,7,8-HPCDD	58.6
13C-OCDD	53.3
13C-2,3,7,8-TCDF	54.2
13C-1,2,3,7,8-PECDF	58.7
13C-1,2,3,4,7,8-HXCDF	60.3
13C-1,2,3,4,6,7,8-HPCDF	61.2

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-032	<b>AXYS FILE:</b>	L7744-13
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	11-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	27-Apr-2005
<b>SAMPLE SIZE:</b>	10.8 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	34.4	<b>ANALYSIS DATE:</b>	14-May-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	1.53	0.0460		
1,2,3,7,8-PECDD	0.478	0.0460		
1,2,3,4,7,8-HXCDD	0.412	0.0460		
1,2,3,6,7,8-HXCDD	1.56	0.0460		
1,2,3,7,8,9-HXCDD	2.39	0.0460		
1,2,3,4,6,7,8-HPCDD	31.3	0.0543		
OCDD	252	0.454		
2,3,7,8-TCDF *	0.379	0.0463		
1,2,3,7,8-PECDF	0.426	0.0460		
2,3,4,7,8-PECDF	0.484	0.0460		
1,2,3,4,7,8-HXCDF	0.771	0.0460		
1,2,3,6,7,8-HXCDF	0.535	0.0460		
2,3,4,6,7,8-HXCDF	0.457	0.0460		
1,2,3,7,8,9-HXCDF	0.532	0.0460		
1,2,3,4,6,7,8-HPCDF	5.08	0.0460		
1,2,3,4,7,8,9-HPCDF	0.418	0.0460		
OCDF	8.85	0.0460		
TOTAL TETRA-DIOXINS	4.13	0.0460		
TOTAL PENTA-DIOXINS	4.18	0.0460		
TOTAL HEXA-DIOXINS	13.6	0.0460		
TOTAL HEPTA-DIOXINS	60.2	0.0460		
TOTAL TETRA-FURANS	9.47	0.0460		
TOTAL PENTA-FURANS	6.81	0.0460		
TOTAL HEXA-FURANS	9.59	0.0460		
TOTAL HEPTA-FURANS	12.8	0.0460		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	3.37
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	3.37

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	76.0
13C-1,2,3,7,8-PECDD	80.8
13C-1,2,3,6,7,8-HXCDD	77.2
13C-1,2,3,4,6,7,8-HPCDD	75.3
13C-OCDD	73.1
13C-2,3,7,8-TCDF	75.3
13C-1,2,3,7,8-PECDF	75.7
13C-1,2,3,4,7,8-HXCDF	76.5
13C-1,2,3,4,6,7,8-HPCDF	76.3

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: B. White QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-033	<b>AXYS FILE:</b>	L8155-10 R
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	03-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	21-Oct-2005
<b>SAMPLE SIZE:</b>	10.5 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	34.9	<b>ANALYSIS DATE:</b>	29-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	1.33	0.0480		
1,2,3,7,8-PECDD	0.460	0.0480		
1,2,3,4,7,8-HXCDD	0.392	0.0480		
1,2,3,6,7,8-HXCDD	1.62	0.0480		
1,2,3,7,8,9-HXCDD	2.56	0.0480		
1,2,3,4,6,7,8-HPCDD	30.9	0.0624		
OCDD	241	0.0885		
2,3,7,8-TCDF *	0.315	0.0480		
1,2,3,7,8-PECDF	0.397	0.0480		
2,3,4,7,8-PECDF	0.390	0.0480		
1,2,3,4,7,8-HXCDF	0.682	0.0480		
1,2,3,6,7,8-HXCDF	0.495	0.0480		
2,3,4,6,7,8-HXCDF	0.437	0.0480		
1,2,3,7,8,9-HXCDF	0.446	0.0480		
1,2,3,4,6,7,8-HPCDF	5.57	0.0480		
1,2,3,4,7,8,9-HPCDF	0.444	0.0480		
OCDF	10.8	0.0480		
TOTAL TETRA-DIOXINS	3.34	0.0480		
TOTAL PENTA-DIOXINS	3.50	0.0480		
TOTAL HEXA-DIOXINS	12.2	0.0480		
TOTAL HEPTA-DIOXINS	57.0	0.0624		
TOTAL TETRA-FURANS	6.95	0.0679		
TOTAL PENTA-FURANS	5.77	0.0480	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEXA-FURANS	9.38	0.0480	2,3,7,8-TCDD TEQs (ND=0) =	3.09
TOTAL HEPTA-FURANS	14.0	0.0480	2,3,7,8-TCDD TEQs (ND=1/2 DL) =	3.09

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	66.9
13C-1,2,3,7,8-PECDD	73.6
13C-1,2,3,6,7,8-HXCDD	67.7
13C-1,2,3,4,6,7,8-HPCDD	66.3
13C-OCDD	64.5
13C-2,3,7,8-TCDF	64.9
13C-1,2,3,7,8-PECDF	69.6
13C-1,2,3,4,7,8-HXCDF	67.2
13C-1,2,3,4,6,7,8-HPCDF	66.1

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*Paul HZ*

QA/QC Chemist





**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-034	<b>AXYS FILE:</b>	L7744-14
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	11-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	27-Apr-2005
<b>SAMPLE SIZE:</b>	10.6 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	13.4	<b>ANALYSIS DATE:</b>	14-May-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	53.4	0.0470	
1,2,3,7,8-PECDD	2.44	0.0470	
1,2,3,4,7,8-HxCDD	3.09	0.0620	
1,2,3,6,7,8-HxCDD	9.81	0.0620	
1,2,3,7,8,9-HxCDD	10.3	0.0620	
1,2,3,4,6,7,8-HPCDD	237	0.220	
OCDD	1910	0.135	
2,3,7,8-TCDF *	2.67	0.0471	
1,2,3,7,8-PECDF	3.20	0.0470	
2,3,4,7,8-PECDF	2.47	0.0470	
1,2,3,4,7,8-HxCDF	6.53	0.0470	
1,2,3,6,7,8-HxCDF	3.41	0.0470	
2,3,4,6,7,8-HxCDF	2.71	0.0470	
1,2,3,7,8,9-HxCDF	0.537	0.0470	
1,2,3,4,6,7,8-HPCDF	42.1	0.0690	
1,2,3,4,7,8,9-HPCDF	3.38	0.0690	
OCDF	81.3	0.0470	
TOTAL TETRA-DIOXINS	61.5	0.0470	
TOTAL PENTA-DIOXINS	21.4	0.0470	
TOTAL HEXA-DIOXINS	87.4	0.0620	
TOTAL HEPTA-DIOXINS	526	0.220	
TOTAL TETRA-FURANS	29.0	0.0700	
TOTAL PENTA-FURANS	39.5	0.0470	
TOTAL HEXA-FURANS	71.1	0.0470	
TOTAL HEPTA-FURANS	122	0.0690	
		<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
		2,3,7,8-TCDD TEQs (ND=0) =	64.2
		2,3,7,8-TCDD TEQs (ND=1/2 DL) =	64.2

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	64.3
13C-1,2,3,7,8-PECDD	68.4
13C-1,2,3,6,7,8-HxCDD	63.7
13C-1,2,3,4,6,7,8-HPCDD	63.0
13C-OCDD	61.9
13C-2,3,7,8-TCDF	65.0
13C-1,2,3,7,8-PECDF	65.4
13C-1,2,3,4,7,8-HxCDF	66.9
13C-1,2,3,4,6,7,8-HPCDF	59.3

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5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*B. Wake*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

CLIENT SAMPLE I.D.:	05VN-035	AXYS FILE:	L8155-11 R
SAMPLE COLLECTION:	N/A	REPORT DATE:	03-Nov-2005
CLIENT NO.:	2607	METHOD NO.:	AXYS METHOD MLA-017 Rev 10
SAMPLE TYPE:	SOIL	EXTRACTION DATE:	21-Oct-2005
SAMPLE SIZE:	10.3 g (dry)	INSTRUMENT:	HR GC/MS
% Moisture:	40.1	ANALYSIS DATE:	29-Oct-2005
		CONCENTRATION IN:	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	4.13	0.0490		
1,2,3,7,8-PECDD	0.655	0.0490		
1,2,3,4,7,8-HXCDD	0.638	0.0490		
1,2,3,6,7,8-HXCDD	2.42	0.0490		
1,2,3,7,8,9-HXCDD	3.57	0.0490		
1,2,3,4,6,7,8-HPCDD	50.3	0.0752		
OCDD	430	0.153		
2,3,7,8-TCDF *	0.341	0.0490		
1,2,3,7,8-PECDF	0.389	0.0490		
2,3,4,7,8-PECDF	0.321	0.0490		
1,2,3,4,7,8-HXCDF	0.814	0.0490		
1,2,3,6,7,8-HXCDF	0.710	0.0490		
2,3,4,6,7,8-HXCDF	0.296	0.0490		
1,2,3,7,8,9-HXCDF	1.07	0.0490		
1,2,3,4,6,7,8-HPCDF	7.67	0.0490		
1,2,3,4,7,8,9-HPCDF	0.548	0.0490		
OCDF	14.5	0.0490		
TOTAL TETRA-DIOXINS	6.28	0.0490		
TOTAL PENTA-DIOXINS	4.74	0.0490		
TOTAL HEXA-DIOXINS	21.0	0.0490		
TOTAL HEPTA-DIOXINS	96.8	0.0752		
TOTAL TETRA-FURANS	6.24	0.0490		
TOTAL PENTA-FURANS	6.13	0.0490	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEXA-FURANS	12.6	0.0490	2,3,7,8-TCDD TEQs (ND=0) =	6.58
TOTAL HEPTA-FURANS	18.7	0.0490	2,3,7,8-TCDD TEQs (ND=1/2 DL) =	6.58

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	84.3
13C-1,2,3,7,8-PECDD	91.2
13C-1,2,3,6,7,8-HXCDD	84.4
13C-1,2,3,4,6,7,8-HPCDD	82.3
13C-OCDD	77.6
13C-2,3,7,8-TCDF	81.1
13C-1,2,3,7,8-PECDF	86.9
13C-1,2,3,4,7,8-HXCDF	87.2
13C-1,2,3,4,6,7,8-HPCDF	86.6

1. SDL = Sample Detection Limit
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3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
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5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*Robert H*

QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-036	<b>AXYS FILE:</b>	L7744-15
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	11-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	27-Apr-2005
<b>SAMPLE SIZE:</b>	10.7 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	13.0	<b>ANALYSIS DATE:</b>	14-May-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	2.34	0.0470		
1,2,3,7,8-PECDD	18.8	0.0470		
1,2,3,4,7,8-HXCDD	32.7	0.460		
1,2,3,6,7,8-HXCDD	116	0.460		
1,2,3,7,8,9-HXCDD	87.6	0.460		
1,2,3,4,6,7,8-HPCDD	2860	0.494		
OCDD	21000	0.237		
2,3,7,8-TCDF *	0.948	0.0466		
1,2,3,7,8-PECDF	4.49	0.100		
2,3,4,7,8-PECDF	5.00	0.102		
1,2,3,4,7,8-HXCDF	28.8	0.0960		
1,2,3,6,7,8-HXCDF	33.9	0.0960		
2,3,4,6,7,8-HXCDF	22.6	0.0960		
1,2,3,7,8,9-HXCDF	0.929	0.0962		
1,2,3,4,6,7,8-HPCDF	659	0.190		
1,2,3,4,7,8,9-HPCDF	27.8	0.190		
OCDF	1040	0.0470		
TOTAL TETRA-DIOXINS	7.28	0.0470		
TOTAL PENTA-DIOXINS	76.6	0.0470		
TOTAL HEXA-DIOXINS	758	0.460		
TOTAL HEPTA-DIOXINS	5020	0.490		
TOTAL TETRA-FURANS	14.8	0.0470		
TOTAL PENTA-FURANS	154	0.100		
TOTAL HEXA-FURANS	836	0.0960		
TOTAL HEPTA-FURANS	1720	0.190		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	93.9
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	93.9

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	84.9
13C-1,2,3,7,8-PECDD	88.6
13C-1,2,3,6,7,8-HXCDD	85.7
13C-1,2,3,4,6,7,8-HPCDD	112
13C-OCDD	87.8
13C-2,3,7,8-TCDF	82.1
13C-1,2,3,7,8-PECDF	83.5
13C-1,2,3,4,7,8-HXCDF	85.3
13C-1,2,3,4,6,7,8-HPCDF	91.1

1. SDL = Sample Detection Limit
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4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: B. Wake                      QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-037	<b>AXYS FILE:</b>	L7744-16 i
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	11-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	27-Apr-2005
<b>SAMPLE SIZE:</b>	9.50 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	21.4	<b>ANALYSIS DATE:</b>	19-May-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	16.8	0.0530		
1,2,3,7,8-PECDD	0.987	0.0530		
1,2,3,4,7,8-HXCDD	0.528	0.0530		
1,2,3,6,7,8-HXCDD	2.03	0.0530		
1,2,3,7,8,9-HXCDD	5.03	0.0530		
1,2,3,4,6,7,8-HPCDD	35.9	0.0586		
OCDD	238	0.0649		
2,3,7,8-TCDF *	0.483	0.0526		
1,2,3,7,8-PECDF	0.319	0.0530		
2,3,4,7,8-PECDF	0.262	0.0530		
1,2,3,4,7,8-HXCDF	0.533	0.0530		
1,2,3,6,7,8-HXCDF	0.397	0.0530		
2,3,4,6,7,8-HXCDF	0.324	0.0530		
1,2,3,7,8,9-HXCDF	1.05	0.0530		
1,2,3,4,6,7,8-HPCDF	5.53	0.0650		
1,2,3,4,7,8,9-HPCDF	0.416	0.0650		
OCDF	10.2	0.0530		
TOTAL TETRA-DIOXINS	19.3	0.0530		
TOTAL PENTA-DIOXINS	6.82	0.0530		
TOTAL HEXA-DIOXINS	22.1	0.0530		
TOTAL HEPTA-DIOXINS	65.4	0.0530		
TOTAL TETRA-FURANS	8.63	0.0530		
TOTAL PENTA-FURANS	4.71	0.0530		
TOTAL HEXA-FURANS	8.71	0.0530		
TOTAL HEPTA-FURANS	13.1	0.0650		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	19.4
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	19.4

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	75.2
13C-1,2,3,7,8-PECDD	82.2
13C-1,2,3,6,7,8-HXCDD	73.6
13C-1,2,3,4,6,7,8-HPCDD	71.2
13C-OCDD	66.9
13C-2,3,7,8-TCDF	73.7
13C-1,2,3,7,8-PECDF	78.1
13C-1,2,3,4,7,8-HXCDF	75.6
13C-1,2,3,4,6,7,8-HPCDF	69.9

1. SDL = Sample Detection Limit
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3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*B. White*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

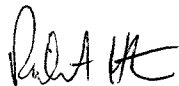
<b>CLIENT SAMPLE I.D.:</b>	05VN-038	<b>AXYS FILE:</b>	L8155-12 R
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	03-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	21-Oct-2005
<b>SAMPLE SIZE:</b>	10.6 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	36.2	<b>ANALYSIS DATE:</b>	29-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	3.75	0.0470		
1,2,3,7,8-PCDD	0.301	0.0470		
1,2,3,4,7,8-HXCDD	0.162	0.0470		
1,2,3,6,7,8-HXCDD	0.750	0.0470		
1,2,3,7,8,9-HXCDD	2.53	0.0470		
1,2,3,4,6,7,8-HPCDD	12.3	0.0470		
OCDD	111	0.0869		
2,3,7,8-TCDF *	0.161	0.0470		
1,2,3,7,8-PCDF	0.176	0.0470		
2,3,4,7,8-PCDF	0.133	0.0470		
1,2,3,4,7,8-HXCDF	0.198	0.0470		
1,2,3,6,7,8-HXCDF	0.165	0.0470		
2,3,4,6,7,8-HXCDF	0.087	0.0470		
1,2,3,7,8,9-HXCDF	0.589	0.0470		
1,2,3,4,6,7,8-HPCDF	1.61	0.0470		
1,2,3,4,7,8,9-HPCDF	0.129	0.0470		
OCDF	2.92	0.0470		
TOTAL TETRA-DIOXINS	4.76	0.0470		
TOTAL PENTA-DIOXINS	1.98	0.0470		
TOTAL HEXA-DIOXINS	8.47	0.0470		
TOTAL HEPTA-DIOXINS	24.5	0.0470		
TOTAL TETRA-FURANS	2.51	0.0470		
TOTAL PENTA-FURANS	1.94	0.0470		
TOTAL HEXA-FURANS	3.43	0.0470		
TOTAL HEPTA-FURANS	4.07	0.0470		
			2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
			2,3,7,8-TCDD TEQs (ND=0) =	4.74
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	4.74

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	86.5
13C-1,2,3,7,8-PCDD	98.2
13C-1,2,3,6,7,8-HXCDD	92.2
13C-1,2,3,4,6,7,8-HPCDD	87.7
13C-OCDD	76.9
13C-2,3,7,8-TCDF	83.5
13C-1,2,3,7,8-PCDF	92.1
13C-1,2,3,4,7,8-HXCDF	90.9
13C-1,2,3,4,6,7,8-HPCDF	87.3

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-039

**AXYS FILE:** L7744-17

**SAMPLE COLLECTION:** N/A

**CLIENT NO.:** 2607

**REPORT DATE:** 11-Jun-2005

**METHOD NO.:** AXYS METHOD MLA-017 Rev 09

**SAMPLE TYPE:** SOIL

**EXTRACTION DATE:** 27-Apr-2005

**SAMPLE SIZE:** 10.7 g (dry)

**INSTRUMENT:** HR GC/MS

**ANALYSIS DATE:** 14-May-2005

**% Moisture:** 37.4

**CONCENTRATION IN:** pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)
2,3,7,8-TCDD	4.01	0.0470
1,2,3,7,8-PECDD	0.456	0.0470
1,2,3,4,7,8-HxCDD	0.375	0.0560
1,2,3,6,7,8-HxCDD	NDR (1.15)	0.0560
1,2,3,7,8,9-HxCDD	2.21	0.0560
1,2,3,4,6,7,8-HPCDD	21.7	0.0873
OCDD	161	0.0470
2,3,7,8-TCDF *	0.246	0.0471
1,2,3,7,8-PECDF	0.260	0.0470
2,3,4,7,8-PECDF	0.217	0.0470
1,2,3,4,7,8-HxCDF	0.357	0.0510
1,2,3,6,7,8-HxCDF	NDR (0.241)	0.0510
2,3,4,6,7,8-HxCDF	0.210	0.0510
1,2,3,7,8,9-HxCDF	0.454	0.0510
1,2,3,4,6,7,8-HPCDF	3.34	0.0470
1,2,3,4,7,8,9-HPCDF	NDR (0.200)	0.0470
OCDF	6.32	0.0470
TOTAL TETRA-DIOXINS	5.15	0.0470
TOTAL PENTA-DIOXINS	2.32	0.0470
TOTAL HEXA-DIOXINS	9.51	0.0560
TOTAL HEPTA-DIOXINS	40.4	0.0470
TOTAL TETRA-FURANS	3.10	0.0470
TOTAL PENTA-FURANS	3.09	0.0470
TOTAL HEXA-FURANS	5.57	0.0510
TOTAL HEPTA-FURANS	8.49	0.0470

**2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)**

2,3,7,8-TCDD TEQs (ND=0) = 5.24  
2,3,7,8-TCDD TEQs (ND=1/2 DL) = 5.25

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	34.7
13C-1,2,3,7,8-PECDD	40.0
13C-1,2,3,6,7,8-HxCDD	39.3
13C-1,2,3,4,6,7,8-HPCDD	38.3
13C-OCDD	35.1
13C-2,3,7,8-TCDF	34.5
13C-1,2,3,7,8-PECDF	36.9
13C-1,2,3,4,7,8-HxCDF	41.3
13C-1,2,3,4,6,7,8-HPCDF	37.6

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*B. W. Lake*

QA/QC Chemist





**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-040	<b>AXYS FILE:</b>	L8155-13 R
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	03-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	21-Oct-2005
<b>SAMPLE SIZE:</b>	11.0 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
		<b>ANALYSIS DATE:</b>	29-Oct-2005
<b>% Moisture:</b>	40.6	<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

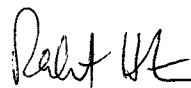
COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	5.85	0.0450		
1,2,3,7,8-PECDD	0.322	0.0450		
1,2,3,4,7,8-HXCDD	0.258	0.0450		
1,2,3,6,7,8-HXCDD	1.13	0.0450		
1,2,3,7,8,9-HXCDD	1.99	0.0450		
1,2,3,4,6,7,8-HPCDD	23.6	0.0458		
OCDD	182	0.0474		
2,3,7,8-TCDF *	0.284	0.0450		
1,2,3,7,8-PECDF	0.233	0.0450		
2,3,4,7,8-PECDF	0.238	0.0450		
1,2,3,4,7,8-HXCDF	0.511	0.0450		
1,2,3,6,7,8-HXCDF	0.280	0.0450		
2,3,4,6,7,8-HXCDF	0.219	0.0450		
1,2,3,7,8,9-HXCDF	0.164	0.0450		
1,2,3,4,6,7,8-HPCDF	3.70	0.0450		
1,2,3,4,7,8,9-HPCDF	0.235	0.0450		
OCDF	6.16	0.0450		
TOTAL TETRA-DIOXINS	6.84	0.0450		
TOTAL PENTA-DIOXINS	2.13	0.0450		
TOTAL HEXA-DIOXINS	8.68	0.0450		
TOTAL HEPTA-DIOXINS	43.6	0.0458		
TOTAL TETRA-FURANS	4.07	0.0450		
TOTAL PENTA-FURANS	3.69	0.0450		
TOTAL HEXA-FURANS	6.36	0.0450	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEPTA-FURANS	9.00	0.0450	2,3,7,8-TCDD TEQs (ND=0) =	7.08
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	7.08

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	67.8
13C-1,2,3,7,8-PECDD	82.4
13C-1,2,3,6,7,8-HXCDD	77.6
13C-1,2,3,4,6,7,8-HPCDD	78.7
13C-OCDD	69.8
13C-2,3,7,8-TCDF	62.0
13C-1,2,3,7,8-PECDF	77.1
13C-1,2,3,4,7,8-HXCDF	76.7
13C-1,2,3,4,6,7,8-HPCDF	77.3

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-042	<b>AXYS FILE:</b>	L7744-18
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	11-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	27-Apr-2005
<b>SAMPLE SIZE:</b>	10.8 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
		<b>ANALYSIS DATE:</b>	14-May-2005
<b>% Moisture:</b>	17.6	<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	15.0	0.0460		
1,2,3,7,8-PECDD	1.76	0.0460		
1,2,3,4,7,8-HxCDD	2.87	0.0460		
1,2,3,6,7,8-HxCDD	8.97	0.0460		
1,2,3,7,8,9-HxCDD	8.79	0.0460		
1,2,3,4,6,7,8-HPCDD	223	0.0760		
OCDD	1530	0.313		
2,3,7,8-TCDF *	0.870	0.0463		
1,2,3,7,8-PECDF	0.447	0.0460		
2,3,4,7,8-PECDF	0.665	0.0460		
1,2,3,4,7,8-HxCDF	2.46	0.150		
1,2,3,6,7,8-HxCDF	1.77	0.150		
2,3,4,6,7,8-HxCDF	1.32	0.150		
1,2,3,7,8,9-HxCDF	0.401	0.150		
1,2,3,4,6,7,8-HPCDF	39.0	0.0640		
1,2,3,4,7,8,9-HPCDF	2.59	0.0640		
OCDF	77.2	0.0460		
TOTAL TETRA-DIOXINS	17.5	0.0460		
TOTAL PENTA-DIOXINS	10.3	0.0460		
TOTAL HEXA-DIOXINS	60.6	0.0460		
TOTAL HEPTA-DIOXINS	380	0.0760		
TOTAL TETRA-FURANS	10.6	0.0460		
TOTAL PENTA-FURANS	13.6	0.0460		
TOTAL HEXA-FURANS	47.9	0.150		
TOTAL HEPTA-FURANS	111	0.0640		
				<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>
				2,3,7,8-TCDD TEQs (ND=0) = 22.7
				2,3,7,8-TCDD TEQs (ND=1/2 DL) = 22.7

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	75.6
13C-1,2,3,7,8-PECDD	80.2
13C-1,2,3,6,7,8-HxCDD	75.1
13C-1,2,3,4,6,7,8-HPCDD	78.5
13C-OCDD	83.3
13C-2,3,7,8-TCDF	72.0
13C-1,2,3,7,8-PECDF	76.0
13C-1,2,3,4,7,8-HxCDF	74.4
13C-1,2,3,4,6,7,8-HPCDF	69.1

1. SDL = Sample Detection Limit
2. ND = Not detected
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4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*B. White*

QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-043

**AXYS FILE:** L7744-19 i

**SAMPLE COLLECTION:** N/A

**CLIENT NO.:** 2607

**REPORT DATE:** 11-Jun-2005

**METHOD NO.:** AXYS METHOD MLA-017 Rev 09

**SAMPLE TYPE:** SOIL

**EXTRACTION DATE:** 27-Apr-2005

**SAMPLE SIZE:** 11.8 g (dry)

**INSTRUMENT:** HR GC/MS

**ANALYSIS DATE:** 19-May-2005

**% Moisture:** 38.3

**CONCENTRATION IN:** pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	0.575	0.0430		
1,2,3,7,8-PECDD	0.179	0.0430		
1,2,3,4,7,8-HxCDD	NDR (0.072)	0.0430		
1,2,3,6,7,8-HxCDD	0.262	0.0430		
1,2,3,7,8,9-HxCDD	1.14	0.0430		
1,2,3,4,6,7,8-HPCDD	2.73	0.0430		
OCDD	20.8	0.0430		
2,3,7,8-TCDF *	0.049	0.0426		
1,2,3,7,8-PECDF	0.088	0.0430		
2,3,4,7,8-PECDF	NDR (0.080)	0.0430		
1,2,3,4,7,8-HxCDF	0.068	0.0430		
1,2,3,6,7,8-HxCDF	0.071	0.0430		
2,3,4,6,7,8-HxCDF	0.055	0.0430		
1,2,3,7,8,9-HxCDF	0.250	0.0430		
1,2,3,4,6,7,8-HPCDF	0.401	0.0430		
1,2,3,4,7,8,9-HPCDF	NDR (0.058)	0.0430		
OCDF	0.753	0.0430		
TOTAL TETRA-DIOXINS	0.884	0.0430		
TOTAL PENTA-DIOXINS	0.671	0.0430		
TOTAL HEXA-DIOXINS	2.69	0.0430		
TOTAL HEPTA-DIOXINS	5.56	0.0430		
TOTAL TETRA-FURANS	0.839	0.0430		
TOTAL PENTA-FURANS	0.607	0.0430		
TOTAL HEXA-FURANS	0.987	0.0430		
TOTAL HEPTA-FURANS	0.923	0.0430		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	0.981
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	0.994

**Surrogate Standards** **% Recovery**

13C-2,3,7,8-TCDD	69.4
13C-1,2,3,7,8-PECDD	78.1
13C-1,2,3,6,7,8-HxCDD	71.9
13C-1,2,3,4,6,7,8-HPCDD	72.2
13C-OCDD	70.4
13C-2,3,7,8-TCDF	67.7
13C-1,2,3,7,8-PECDF	73.3
13C-1,2,3,4,7,8-HxCDF	72.9
13C-1,2,3,4,6,7,8-HPCDF	69.6

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*B. Watson*

QA/QC Chemist



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## **Appendix A4.3**

### **Dioxin Data: Phu Cat**

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**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	04VN-008	<b>AXYS FILE:</b>	L7508-2 RX
<b>SAMPLE COLLECTION:</b>	29-Feb-2004	<b>REPORT DATE:</b>	26-May-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	18-Jan-2005
<b>SAMPLE SIZE:</b>	5.74 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
		<b>ANALYSIS DATE:</b>	10-Mar-2005
<b>% Moisture:</b>	37.5	<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	194	0.0870	
1,2,3,7,8-PECDD	4.08	0.0870	
1,2,3,4,7,8-HXCDD	0.762	0.130	
1,2,3,6,7,8-HXCDD	3.76	0.130	
1,2,3,7,8,9-HXCDD	2.73	0.130	
1,2,3,4,6,7,8-HPCDD	38.7	0.0988	
OCDD	312	0.117	
2,3,7,8-TCDF *	11.6	0.0870	
1,2,3,7,8-PECDF	0.976	0.200	
2,3,4,7,8-PECDF	1.31	0.201	
1,2,3,4,7,8-HXCDF	1.36	0.0870	
1,2,3,6,7,8-HXCDF	0.791	0.0870	
2,3,4,6,7,8-HXCDF	0.726	0.0870	
1,2,3,7,8,9-HXCDF	ND	0.0870	
1,2,3,4,6,7,8-HPCDF	8.02	0.0870	
1,2,3,4,7,8,9-HPCDF	0.430	0.0870	
OCDF	12.4	0.0870	
TOTAL TETRA-DIOXINS	210	0.0870	
TOTAL PENTA-DIOXINS	29.7	0.0870	
TOTAL HEXA-DIOXINS	42.0	0.130	
TOTAL HEPTA-DIOXINS	78.2	0.0988	
TOTAL TETRA-FURANS	60.5	0.496	
TOTAL PENTA-FURANS	85.5	0.200	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)
TOTAL HEXA-FURANS	28.3	0.0870	2,3,7,8-TCDD TEQs (ND=0) = 201
TOTAL HEPTA-FURANS	16.5	0.0870	2,3,7,8-TCDD TEQs (ND=1/2 DL) = 201

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	95.9
13C-1,2,3,7,8-PECDD	95.8
13C-1,2,3,6,7,8-HXCDD	93.9
13C-1,2,3,4,6,7,8-HPCDD	96.4
13C-OCDD	93.1
13C-2,3,7,8-TCDF	90.5
13C-1,2,3,7,8-PECDF	92.3
13C-1,2,3,4,7,8-HXCDF	91.4
13C-1,2,3,4,6,7,8-HPCDF	95.1

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*[Signature]*

QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-045	<b>AXYS FILE:</b>	L7744-20
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	11-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	27-Apr-2005
<b>SAMPLE SIZE:</b>	11.0 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
		<b>ANALYSIS DATE:</b>	14-May-2005
<b>% Moisture:</b>	20.4	<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	3.25	0.0450		
1,2,3,7,8-PECDD	0.405	0.0450		
1,2,3,4,7,8-HXCDD	0.662	0.0620		
1,2,3,6,7,8-HXCDD	2.03	0.0620		
1,2,3,7,8,9-HXCDD	2.30	0.0620		
1,2,3,4,6,7,8-HPCDD	51.8	0.0584		
OCDD	390	0.0450		
2,3,7,8-TCDF *	0.416	0.0453		
1,2,3,7,8-PECDF	0.309	0.0450		
2,3,4,7,8-PECDF	0.271	0.0450		
1,2,3,4,7,8-HXCDF	0.578	0.0450		
1,2,3,6,7,8-HXCDF	1.03	0.0450		
2,3,4,6,7,8-HXCDF	0.463	0.0450		
1,2,3,7,8,9-HXCDF	0.176	0.0450		
1,2,3,4,6,7,8-HPCDF	9.00	0.0450		
1,2,3,4,7,8,9-HPCDF	0.666	0.0450		
OCDF	13.9	0.0450		
TOTAL TETRA-DIOXINS	4.11	0.0450		
TOTAL PENTA-DIOXINS	2.39	0.0450		
TOTAL HEXA-DIOXINS	19.7	0.0620		
TOTAL HEPTA-DIOXINS	111	0.0580		
TOTAL TETRA-FURANS	3.47	0.0450		
TOTAL PENTA-FURANS	5.15	0.0450		
TOTAL HEXA-FURANS	13.3	0.0450		
TOTAL HEPTA-FURANS	20.9	0.0450		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	5.23
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	5.23

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	63.0
13C-1,2,3,7,8-PECDD	69.4
13C-1,2,3,6,7,8-HXCDD	70.1
13C-1,2,3,4,6,7,8-HPCDD	72.0
13C-OCDD	71.9
13C-2,3,7,8-TCDF	59.4
13C-1,2,3,7,8-PECDF	64.8
13C-1,2,3,4,7,8-HXCDF	69.7
13C-1,2,3,4,6,7,8-HPCDF	66.8

1. SDL = Sample Detection Limit
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3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*B. Walker*

QA/QC Chemist





**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

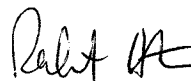
<b>CLIENT SAMPLE I.D.:</b>	05VN-047	<b>AXYS FILE:</b>	L8155-14
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	04-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	23-Sep-2005
<b>SAMPLE SIZE:</b>	10.3 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
		<b>ANALYSIS DATE:</b>	08-Oct-2005
<b>% Moisture:</b>	22.0	<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	0.603	0.0490	
1,2,3,7,8-PECDD	0.118	0.0490	
1,2,3,4,7,8-HXCDD	0.202	0.0559	
1,2,3,6,7,8-HXCDD	0.432	0.0559	
1,2,3,7,8,9-HXCDD	0.596	0.0559	
1,2,3,4,6,7,8-HPCDD	11.8	0.0745	
OCDD	82.9	0.121	
2,3,7,8-TCDF *	0.233	0.0490	
1,2,3,7,8-PECDF	0.087	0.0490	
2,3,4,7,8-PECDF	0.121	0.0490	
1,2,3,4,7,8-HXCDF	0.139	0.0490	
1,2,3,6,7,8-HXCDF	0.199	0.0490	
2,3,4,6,7,8-HXCDF	0.137	0.0490	
1,2,3,7,8,9-HXCDF	0.052	0.0490	
1,2,3,4,6,7,8-HPCDF	2.18	0.0490	
1,2,3,4,7,8,9-HPCDF	0.154	0.0490	
OCDF	3.36	0.0490	
TOTAL TETRA-DIOXINS	1.02	0.0490	
TOTAL PENTA-DIOXINS	0.998	0.0490	
TOTAL HEXA-DIOXINS	5.64	0.0559	
TOTAL HEPTA-DIOXINS	25.5	0.0745	
TOTAL TETRA-FURANS	1.43	0.0490	
TOTAL PENTA-FURANS	1.68	0.0490	
TOTAL HEXA-FURANS	3.47	0.0490	
TOTAL HEPTA-FURANS	4.48	0.0490	
			2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)
			2,3,7,8-TCDD TEQs (ND=0) = 1.13
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 1.13

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	41.4
13C-1,2,3,7,8-PECDD	51.6
13C-1,2,3,6,7,8-HXCDD	47.4
13C-1,2,3,4,6,7,8-HPCDD	47.3
13C-OCDD	42.2
13C-2,3,7,8-TCDF	42.3
13C-1,2,3,7,8-PECDF	45.6
13C-1,2,3,4,7,8-HXCDF	47.5
13C-1,2,3,4,6,7,8-HPCDF	46.1

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

CLIENT SAMPLE I.D.: 05VN-048  
SAMPLE COLLECTION: N/A  
CLIENT NO.: 2607

SAMPLE TYPE: SOIL  
SAMPLE SIZE: 10.5 g (dry)

% Moisture: 19.8

AXYS FILE: L7744-21

REPORT DATE: 14-Jun-2005  
METHOD NO.: AXYS METHOD MLA-017 Rev 09  
EXTRACTION DATE: 28-Apr-2005  
INSTRUMENT: HR GC/MS  
ANALYSIS DATE: 15-May-2005  
CONCENTRATION IN: pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	164	0.0480		
1,2,3,7,8-PECDD	2.32	0.0480		
1,2,3,4,7,8-HXCDD	0.538	0.0961		
1,2,3,6,7,8-HXCDD	1.94	0.0961		
1,2,3,7,8,9-HXCDD	1.72	0.0961		
1,2,3,4,6,7,8-HPCDD	18.5	0.118		
OCDD	165	0.156		
2,3,7,8-TCDF *	14.8	0.0480		
1,2,3,7,8-PECDF	0.803	0.0580		
2,3,4,7,8-PECDF	0.681	0.0580		
1,2,3,4,7,8-HXCDF	0.440	0.0480		
1,2,3,6,7,8-HXCDF	0.334	0.0480		
2,3,4,6,7,8-HXCDF	0.278	0.0480		
1,2,3,7,8,9-HXCDF	0.194	0.0480		
1,2,3,4,6,7,8-HPCDF	3.57	0.0867		
1,2,3,4,7,8,9-HPCDF	0.305	0.0867		
OCDF	4.92	0.0860		
TOTAL TETRA-DIOXINS	173	0.0480		
TOTAL PENTA-DIOXINS	18.9	0.0480		
TOTAL HEXA-DIOXINS	22.1	0.0961		
TOTAL HEPTA-DIOXINS	36.5	0.118		
TOTAL TETRA-FURANS	44.4	0.0480		
TOTAL PENTA-FURANS	52.1	0.0580	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEXA-FURANS	10.9	0.0480	2,3,7,8-TCDD TEQs (ND=0) =	169
TOTAL HEPTA-FURANS	7.07	0.0867	2,3,7,8-TCDD TEQs (ND=1/2 DL) =	169

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	44.8
13C-1,2,3,7,8-PECDD	50.9
13C-1,2,3,6,7,8-HXCDD	40.7
13C-1,2,3,4,6,7,8-HPCDD	43.6
13C-OCDD	38.0
13C-2,3,7,8-TCDF	44.4
13C-1,2,3,7,8-PECDF	47.9
13C-1,2,3,4,7,8-HXCDF	42.5
13C-1,2,3,4,6,7,8-HPCDF	42.5

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

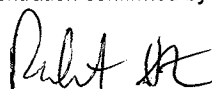
<b>CLIENT SAMPLE I.D.:</b>	05VN-049	<b>AXYS FILE:</b>	L8155-15 (A)
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	04-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	23-Sep-2005
<b>SAMPLE SIZE:</b>	10.5 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	6.28	<b>ANALYSIS DATE:</b>	08-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	0.191	0.0480	
1,2,3,7,8-PECDD	0.055	0.0480	
1,2,3,4,7,8-HXCDD	0.048	0.0480	
1,2,3,6,7,8-HXCDD	0.403	0.0480	
1,2,3,7,8,9-HXCDD	0.663	0.0480	
1,2,3,4,6,7,8-HPCDD	3.08	0.0594	
OCDD	26.1	0.0794	
2,3,7,8-TCDF *	0.084	0.0480	
1,2,3,7,8-PECDF	ND	0.0480	
2,3,4,7,8-PECDF	0.077	0.0480	
1,2,3,4,7,8-HXCDF	0.078	0.0480	
1,2,3,6,7,8-HXCDF	0.097	0.0480	
2,3,4,6,7,8-HXCDF	ND	0.0480	
1,2,3,7,8,9-HXCDF	0.220	0.0480	
1,2,3,4,6,7,8-HPCDF	0.373	0.0480	
1,2,3,4,7,8,9-HPCDF	ND	0.0480	
OCDF	0.253	0.0480	
TOTAL TETRA-DIOXINS	0.280	0.0480	
TOTAL PENTA-DIOXINS	0.055	0.0480	
TOTAL HEXA-DIOXINS	2.06	0.0480	
TOTAL HEPTA-DIOXINS	5.91	0.0594	
TOTAL TETRA-FURANS	0.281	0.0480	
TOTAL PENTA-FURANS	0.400	0.0480	
TOTAL HEXA-FURANS	0.961	0.0480	
TOTAL HEPTA-FURANS	0.621	0.0480	
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>
			2,3,7,8-TCDD TEQs (ND=0) = 0.481
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 0.485

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	50.8
13C-1,2,3,7,8-PECDD	67.0
13C-1,2,3,6,7,8-HXCDD	62.6
13C-1,2,3,4,6,7,8-HPCDD	62.6
13C-OCDD	55.6
13C-2,3,7,8-TCDF	52.1
13C-1,2,3,7,8-PECDF	59.6
13C-1,2,3,4,7,8-HXCDF	62.3
13C-1,2,3,4,6,7,8-HPCDF	60.7

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-050	<b>AXYS FILE:</b>	L7744-22
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	14-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	28-Apr-2005
<b>SAMPLE SIZE:</b>	10.7 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	21.4	<b>ANALYSIS DATE:</b>	15-May-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	43.2	0.0470	
1,2,3,7,8-PECDD	1.09	0.0470	
1,2,3,4,7,8-HXCDD	0.301	0.0470	
1,2,3,6,7,8-HXCDD	1.31	0.0470	
1,2,3,7,8,9-HXCDD	1.09	0.0470	
1,2,3,4,6,7,8-HPCDD	10.1	0.0470	
OCDD	71.9	0.101	
2,3,7,8-TCDF *	2.28	0.0470	
1,2,3,7,8-PECDF	0.324	0.0470	
2,3,4,7,8-PECDF	0.363	0.0470	
1,2,3,4,7,8-HXCDF	0.360	0.0470	
1,2,3,6,7,8-HXCDF	0.231	0.0470	
2,3,4,6,7,8-HXCDF	0.228	0.0470	
1,2,3,7,8,9-HXCDF	0.254	0.0470	
1,2,3,4,6,7,8-HPCDF	1.59	0.0470	
1,2,3,4,7,8,9-HPCDF	NDR (0.123)	0.0470	
OCDF	1.35	0.0470	
TOTAL TETRA-DIOXINS	48.6	0.0470	
TOTAL PENTA-DIOXINS	9.30	0.0470	
TOTAL HEXA-DIOXINS	16.1	0.0470	
TOTAL HEPTA-DIOXINS	21.5	0.0470	
TOTAL TETRA-FURANS	25.3	0.0470	
TOTAL PENTA-FURANS	25.0	0.0470	
TOTAL HEXA-FURANS	7.68	0.0470	
TOTAL HEPTA-FURANS	2.72	0.0470	
		<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
		2,3,7,8-TCDD TEQs (ND=0) =	45.2
		2,3,7,8-TCDD TEQs (ND=1/2 DL) =	45.2

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	50.6
13C-1,2,3,7,8-PECDD	58.1
13C-1,2,3,6,7,8-HXCDD	48.4
13C-1,2,3,4,6,7,8-HPCDD	49.7
13C-OCDD	46.4
13C-2,3,7,8-TCDF	47.6
13C-1,2,3,7,8-PECDF	53.4
13C-1,2,3,4,7,8-HXCDF	45.4
13C-1,2,3,4,6,7,8-HPCDF	48.1

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2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-051

**AXYS FILE:** L7744-23

**SAMPLE COLLECTION:** N/A

**CLIENT NO.:** 2607

**REPORT DATE:** 14-Jun-2005

**METHOD NO.:** AXYS METHOD MLA-017 Rev 09

**SAMPLE TYPE:** SOIL

**EXTRACTION DATE:** 28-Apr-2005

**SAMPLE SIZE:** 11.9 g (dry)

**INSTRUMENT:** HR GC/MS

**ANALYSIS DATE:** 15-May-2005

**% Moisture:** 8.53

**CONCENTRATION IN:** pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	0.899	0.0420		
1,2,3,7,8-PECDD	NDR (0.184)	0.0420		
1,2,3,4,7,8-HXCDD	0.116	0.0420		
1,2,3,6,7,8-HXCDD	0.617	0.0420		
1,2,3,7,8,9-HXCDD	0.625	0.0420		
1,2,3,4,6,7,8-HPCDD	9.40	0.0420		
OCDD	370	0.107		
2,3,7,8-TCDF *	0.183	0.0420		
1,2,3,7,8-PECDF	0.119	0.0420		
2,3,4,7,8-PECDF	0.213	0.0420		
1,2,3,4,7,8-HXCDF	0.174	0.0420		
1,2,3,6,7,8-HXCDF	0.151	0.0420		
2,3,4,6,7,8-HXCDF	NDR (0.113)	0.0420		
1,2,3,7,8,9-HXCDF	NDR (0.088)	0.0420		
1,2,3,4,6,7,8-HPCDF	0.956	0.0420		
1,2,3,4,7,8,9-HPCDF	NDR (0.086)	0.0420		
OCDF	0.810	0.0420		
TOTAL TETRA-DIOXINS	1.30	0.0420		
TOTAL PENTA-DIOXINS	0.544	0.0420		
TOTAL HEXA-DIOXINS	3.55	0.0420		
TOTAL HEPTA-DIOXINS	19.2	0.0420		
TOTAL TETRA-FURANS	2.35	0.0420		
TOTAL PENTA-FURANS	2.38	0.0420		
TOTAL HEXA-FURANS	2.23	0.0420		
TOTAL HEPTA-FURANS	1.81	0.0420		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	1.34
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	1.36

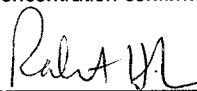
**Surrogate Standards**

**% Recovery**

13C-2,3,7,8-TCDD	69.1
13C-1,2,3,7,8-PECDD	74.7
13C-1,2,3,6,7,8-HXCDD	63.1
13C-1,2,3,4,6,7,8-HPCDD	64.8
13C-OCDD	67.5
13C-2,3,7,8-TCDF	67.0
13C-1,2,3,7,8-PECDF	69.8
13C-1,2,3,4,7,8-HXCDF	62.1
13C-1,2,3,4,6,7,8-HPCDF	64.0

1. SDL = Sample Detection Limit
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3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

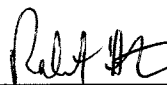
<b>CLIENT SAMPLE I.D.:</b>	05VN-052	<b>AXYS FILE:</b>	L8155-16
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	04-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	23-Sep-2005
<b>SAMPLE SIZE:</b>	10.8 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	14.1	<b>ANALYSIS DATE:</b>	08-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	22.4	0.0460	
1,2,3,7,8-PECDD	0.811	0.0460	
1,2,3,4,7,8-HXCDD	0.216	0.0524	
1,2,3,6,7,8-HXCDD	0.986	0.0524	
1,2,3,7,8,9-HXCDD	0.927	0.0524	
1,2,3,4,6,7,8-HPCDD	8.78	0.0831	
OCDD	123	0.101	
2,3,7,8-TCDF *	1.29	0.0460	
1,2,3,7,8-PECDF	0.244	0.0460	
2,3,4,7,8-PECDF	0.249	0.0460	
1,2,3,4,7,8-HXCDF	0.264	0.0460	
1,2,3,6,7,8-HXCDF	0.191	0.0460	
2,3,4,6,7,8-HXCDF	0.184	0.0460	
1,2,3,7,8,9-HXCDF	0.234	0.0460	
1,2,3,4,6,7,8-HPCDF	1.07	0.0460	
1,2,3,4,7,8,9-HPCDF	0.114	0.0460	
OCDF	1.47	0.0460	
TOTAL TETRA-DIOXINS	25.6	0.0460	
TOTAL PENTA-DIOXINS	8.03	0.0460	
TOTAL HEXA-DIOXINS	14.2	0.0524	
TOTAL HEPTA-DIOXINS	21.0	0.0831	
TOTAL TETRA-FURANS	10.6	0.0460	
TOTAL PENTA-FURANS	7.52	0.0460	
TOTAL HEXA-FURANS	4.89	0.0460	
TOTAL HEPTA-FURANS	2.42	0.0460	
			2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)
			2,3,7,8-TCDD TEQs (ND=0) = 23.9
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 23.9

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	68.3
13C-1,2,3,7,8-PECDD	80.6
13C-1,2,3,6,7,8-HXCDD	82.0
13C-1,2,3,4,6,7,8-HPCDD	80.1
13C-OCDD	73.0
13C-2,3,7,8-TCDF	71.6
13C-1,2,3,7,8-PECDF	74.2
13C-1,2,3,4,7,8-HXCDF	78.7
13C-1,2,3,4,6,7,8-HPCDF	79.1

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist





**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

CLIENT SAMPLE I.D.: 05VN-053  
SAMPLE COLLECTION: N/A  
CLIENT NO.: 2607

SAMPLE TYPE: SEDIMENT  
SAMPLE SIZE: 10.6 g (dry)

% Moisture: 27.0

AXYS FILE: L7744-24

REPORT DATE: 14-Jun-2005  
METHOD NO.: AXYS METHOD MLA-017 Rev 09  
EXTRACTION DATE: 28-Apr-2005  
INSTRUMENT: HR GC/MS  
ANALYSIS DATE: 15-May-2005  
CONCENTRATION IN: pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	0.783	0.0470	
1,2,3,7,8-PECDD	NDR (0.231)	0.0470	
1,2,3,4,7,8-HXCDD	NDR (0.120)	0.0470	
1,2,3,6,7,8-HXCDD	0.502	0.0470	
1,2,3,7,8,9-HXCDD	0.514	0.0470	
1,2,3,4,6,7,8-HPCDD	5.23	0.0470	
OCDD	41.1	0.0470	
2,3,7,8-TCDF *	1.34	0.0470	
1,2,3,7,8-PECDF	0.534	0.0470	
2,3,4,7,8-PECDF	2.09	0.0470	
1,2,3,4,7,8-HXCDF	1.33	0.0470	
1,2,3,6,7,8-HXCDF	0.522	0.0470	
2,3,4,6,7,8-HXCDF	0.788	0.0470	
1,2,3,7,8,9-HXCDF	0.126	0.0470	
1,2,3,4,6,7,8-HPCDF	2.42	0.0470	
1,2,3,4,7,8,9-HPCDF	0.186	0.0470	
OCDF	1.91	0.0470	
TOTAL TETRA-DIOXINS	1.16	0.0470	
TOTAL PENTA-DIOXINS	0.597	0.0470	
TOTAL HEXA-DIOXINS	4.71	0.0470	
TOTAL HEPTA-DIOXINS	11.3	0.0470	
TOTAL TETRA-FURANS	12.4	0.0470	
TOTAL PENTA-FURANS	31.9	0.0470	
TOTAL HEXA-FURANS	20.4	0.0470	
TOTAL HEPTA-FURANS	5.29	0.0470	
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>
			2,3,7,8-TCDD TEQs (ND=0) = 2.45
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 2.48

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	49.3
13C-1,2,3,7,8-PECDD	55.1
13C-1,2,3,6,7,8-HXCDD	44.9
13C-1,2,3,4,6,7,8-HPCDD	47.7
13C-OCDD	45.9
13C-2,3,7,8-TCDF	46.6
13C-1,2,3,7,8-PECDF	50.8
13C-1,2,3,4,7,8-HXCDF	42.0
13C-1,2,3,4,6,7,8-HPCDF	45.2

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*Robert H*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-054

**AXYS FILE:** L7744-25

**SAMPLE COLLECTION:** N/A

**CLIENT NO.:** 2607

**REPORT DATE:** 14-Jun-2005

**METHOD NO.:** AXYS METHOD MLA-017 Rev 09

**SAMPLE TYPE:** SOIL

**EXTRACTION DATE:** 28-Apr-2005

**SAMPLE SIZE:** 10.6 g (dry)

**INSTRUMENT:** HR GC/MS

**ANALYSIS DATE:** 15-May-2005

**% Moisture:** 21.3

**CONCENTRATION IN:** pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	0.754	0.0470		
1,2,3,7,8-PECDD	0.215	0.0470		
1,2,3,4,7,8-HXCDD	0.518	0.0470		
1,2,3,6,7,8-HXCDD	2.10	0.0470		
1,2,3,7,8,9-HXCDD	2.39	0.0470		
1,2,3,4,6,7,8-HPCDD	49.9	0.0909		
OCDD	372	0.266		
2,3,7,8-TCDF *	0.933	0.0470		
1,2,3,7,8-PECDF	0.464	0.0470		
2,3,4,7,8-PECDF	0.443	0.0470		
1,2,3,4,7,8-HXCDF	0.603	0.0470		
1,2,3,6,7,8-HXCDF	1.26	0.0470		
2,3,4,6,7,8-HXCDF	0.310	0.0470		
1,2,3,7,8,9-HXCDF	0.160	0.0470		
1,2,3,4,6,7,8-HPCDF	2.93	0.0573		
1,2,3,4,7,8,9-HPCDF	0.374	0.0573		
OCDF	4.45	0.0478		
TOTAL TETRA-DIOXINS	3.09	0.0470		
TOTAL PENTA-DIOXINS	4.23	0.0470		
TOTAL HEXA-DIOXINS	23.3	0.0470		
TOTAL HEPTA-DIOXINS	102	0.0909		
TOTAL TETRA-FURANS	7.23	0.0470		
TOTAL PENTA-FURANS	8.36	0.0470		
TOTAL HEXA-FURANS	10.6	0.0470		
TOTAL HEPTA-FURANS	7.97	0.0573		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	2.61
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	2.61

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	54.6
13C-1,2,3,7,8-PECDD	59.6
13C-1,2,3,6,7,8-HXCDD	47.7
13C-1,2,3,4,6,7,8-HPCDD	51.9
13C-OCDD	50.2
13C-2,3,7,8-TCDF	55.9
13C-1,2,3,7,8-PECDF	57.5
13C-1,2,3,4,7,8-HXCDF	48.1
13C-1,2,3,4,6,7,8-HPCDF	50.5

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-055  
**SAMPLE COLLECTION:** N/A  
**CLIENT NO.:** 2607

**SAMPLE TYPE:** SEDIMENT  
**SAMPLE SIZE:** 10.4 g (dry)

**% Moisture:** 66.0

**AXYS FILE:** L7744-26

**REPORT DATE:** 14-Jun-2005  
**METHOD NO.:** AXYS METHOD MLA-017 Rev 09  
**EXTRACTION DATE:** 28-Apr-2005  
**INSTRUMENT:** HR GC/MS  
**ANALYSIS DATE:** 15-May-2005  
**CONCENTRATION IN:** pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	2.00	0.0480	
1,2,3,7,8-PECDD	0.999	0.0480	
1,2,3,4,7,8-HXCDD	2.14	0.0556	
1,2,3,6,7,8-HXCDD	8.47	0.0556	
1,2,3,7,8,9-HXCDD	8.53	0.0556	
1,2,3,4,6,7,8-HPCDD	200	0.145	
OCDD	1660	3.93	
2,3,7,8-TCDF *	2.81	0.0470	
1,2,3,7,8-PECDF	2.13	0.0480	
2,3,4,7,8-PECDF	2.48	0.0480	
1,2,3,4,7,8-HXCDF	3.12	0.0480	
1,2,3,6,7,8-HXCDF	4.54	0.0480	
2,3,4,6,7,8-HXCDF	1.93	0.0480	
1,2,3,7,8,9-HXCDF	0.490	0.0480	
1,2,3,4,6,7,8-HPCDF	18.3	0.0481	
1,2,3,4,7,8,9-HPCDF	1.41	0.0481	
OCDF	20.7	0.0820	
TOTAL TETRA-DIOXINS	8.65	0.0480	
TOTAL PENTA-DIOXINS	14.7	0.0480	
TOTAL HEXA-DIOXINS	81.4	0.0556	
TOTAL HEPTA-DIOXINS	425	0.145	
TOTAL TETRA-FURANS	30.3	0.0603	
TOTAL PENTA-FURANS	50.5	0.0480	
TOTAL HEXA-FURANS	54.5	0.0480	
TOTAL HEPTA-FURANS	42.8	0.0481	
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>
			2,3,7,8-TCDD TEQs (ND=0) = 9.91
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 9.91

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	65.5
13C-1,2,3,7,8-PECDD	67.7
13C-1,2,3,6,7,8-HXCDD	62.3
13C-1,2,3,4,6,7,8-HPCDD	65.9
13C-OCDD	71.3
13C-2,3,7,8-TCDF	63.4
13C-1,2,3,7,8-PECDF	65.7
13C-1,2,3,4,7,8-HXCDF	60.9
13C-1,2,3,4,6,7,8-HPCDF	61.2

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-056

**SAMPLE COLLECTION:** N/A

**CLIENT NO.:** 2607

**SAMPLE TYPE:** SEDIMENT

**SAMPLE SIZE:** 10.6 g (dry)

**% Moisture:** 20.2

**AXYS FILE:** L7744-27

**REPORT DATE:** 14-Jun-2005

**METHOD NO.:** AXYS METHOD MLA-017 Rev 09

**EXTRACTION DATE:** 28-Apr-2005

**INSTRUMENT:** HR GC/MS

**ANALYSIS DATE:** 15-May-2005

**CONCENTRATION IN:** pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	0.301	0.0470	
1,2,3,7,8-PECDD	NDR (0.064)	0.0470	
1,2,3,4,7,8-HXCDD	0.169	0.0491	
1,2,3,6,7,8-HXCDD	0.551	0.0491	
1,2,3,7,8,9-HXCDD	0.427	0.0491	
1,2,3,4,6,7,8-HPCDD	11.1	0.0532	
OCDD	102	0.0992	
2,3,7,8-TCDF *	0.207	0.0470	
1,2,3,7,8-PECDF	0.196	0.0470	
2,3,4,7,8-PECDF	0.276	0.0470	
1,2,3,4,7,8-HXCDF	NDR (0.237)	0.0470	
1,2,3,6,7,8-HXCDF	0.270	0.0470	
2,3,4,6,7,8-HXCDF	0.147	0.0470	
1,2,3,7,8,9-HXCDF	0.047	0.0470	
1,2,3,4,6,7,8-HPCDF	1.35	0.0470	
1,2,3,4,7,8,9-HPCDF	0.081	0.0470	
OCDF	1.48	0.0470	
TOTAL TETRA-DIOXINS	0.301	0.0470	
TOTAL PENTA-DIOXINS	0.242	0.0470	
TOTAL HEXA-DIOXINS	4.52	0.0491	
TOTAL HEPTA-DIOXINS	23.9	0.0532	
TOTAL TETRA-FURANS	2.24	0.0470	
TOTAL PENTA-FURANS	3.98	0.0470	
TOTAL HEXA-FURANS	4.18	0.0470	
TOTAL HEPTA-FURANS	2.93	0.0470	
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>
			2,3,7,8-TCDD TEQs (ND=0) = 0.766
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 0.792

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	43.4
13C-1,2,3,7,8-PECDD	48.8
13C-1,2,3,6,7,8-HXCDD	43.8
13C-1,2,3,4,6,7,8-HPCDD	43.3
13C-OCDD	40.5
13C-2,3,7,8-TCDF	44.3
13C-1,2,3,7,8-PECDF	44.7
13C-1,2,3,4,7,8-HXCDF	44.6
13C-1,2,3,4,6,7,8-HPCDF	42.5

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*Rubert H*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE ID.:** 05VN-057  
**SAMPLE COLLECTION:** N/A  
**CLIENT NO.:** 2607

**AXYS FILE:** L7744-28

**SAMPLE TYPE:** SEDIMENT  
**SAMPLE SIZE:** 10.4 g (dry)

**REPORT DATE:** 26-May-2005  
**METHOD NO.:** AXYS METHOD MLA-017 Rev 09  
**EXTRACTION DATE:** 24-Apr-2005  
**INSTRUMENT:** HR GC/MS  
**ANALYSIS DATE:** 06-May-2005  
**CONCENTRATION IN:** pg/g (dry weight basis)

**% Moisture:** 48.2

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	2.52	0.0480		
1,2,3,7,8-PECDD	0.779	0.0480		
1,2,3,4,7,8-HXCDD	1.08	0.0480		
1,2,3,6,7,8-HXCDD	3.49	0.0480		
1,2,3,7,8,9-HXCDD	3.39	0.0480		
1,2,3,4,6,7,8-HPCDD	66.3	0.0494		
OCDD	524	0.0627		
2,3,7,8-TCDF *	3.06	0.0480		
1,2,3,7,8-PECDF	1.30	0.0480		
2,3,4,7,8-PECDF	2.61	0.0480		
1,2,3,4,7,8-HXCDF	2.37	0.0480		
1,2,3,6,7,8-HXCDF	1.75	0.0480		
2,3,4,6,7,8-HXCDF	1.54	0.0480		
1,2,3,7,8,9-HXCDF	0.306	0.0480		
1,2,3,4,6,7,8-HPCDF	9.47	0.0480		
1,2,3,4,7,8,9-HPCDF	0.768	0.0480		
OCDF	11.7	0.0480		
TOTAL TETRA-DIOXINS	9.23	0.0480		
TOTAL PENTA-DIOXINS	7.81	0.0480		
TOTAL HEXA-DIOXINS	32.2	0.0480		
TOTAL HEPTA-DIOXINS	146	0.0480		
TOTAL TETRA-FURANS	28.0	0.0583		
TOTAL PENTA-FURANS	40.5	0.0480		
TOTAL HEXA-FURANS	29.6	0.0480		
TOTAL HEPTA-FURANS	22.3	0.0480		
				<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>
				2,3,7,8-TCDD TEQs (ND=0) = 7.19
				2,3,7,8-TCDD TEQs (ND=1/2 DL) = 7.19

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	79.3
13C-1,2,3,7,8-PECDD	79.6
13C-1,2,3,6,7,8-HXCDD	75.3
13C-1,2,3,4,6,7,8-HPCDD	98.7
13C-OCDD	82.8
13C-2,3,7,8-TCDF	78.6
13C-1,2,3,7,8-PECDF	81.8
13C-1,2,3,4,7,8-HXCDF	82.8
13C-1,2,3,4,6,7,8-HPCDF	81.4

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-058	<b>AXYS FILE:</b>	L8155-17
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	04-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	23-Sep-2005
<b>SAMPLE SIZE:</b>	10.4 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	6.48	<b>ANALYSIS DATE:</b>	08-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	0.554	0.0480		
1,2,3,7,8-PECDD	0.141	0.0480		
1,2,3,4,7,8-HXCDD	0.120	0.0480		
1,2,3,6,7,8-HXCDD	0.618	0.0480		
1,2,3,7,8,9-HXCDD	0.665	0.0480		
1,2,3,4,6,7,8-HPCDD	6.01	0.0703		
OCDD	42.1	0.0952		
2,3,7,8-TCDF *	0.100	0.0480		
1,2,3,7,8-PECDF	0.154	0.0480		
2,3,4,7,8-PECDF	0.158	0.0480		
1,2,3,4,7,8-HXCDF	0.158	0.0480		
1,2,3,6,7,8-HXCDF	0.200	0.0480		
2,3,4,6,7,8-HXCDF	0.139	0.0480		
1,2,3,7,8,9-HXCDF	0.485	0.0480		
1,2,3,4,6,7,8-HPCDF	0.776	0.0480		
1,2,3,4,7,8,9-HPCDF	0.065	0.0480		
OCDF	0.655	0.0480		
TOTAL TETRA-DIOXINS	1.25	0.0480		
TOTAL PENTA-DIOXINS	0.943	0.0480		
TOTAL HEXA-DIOXINS	4.19	0.0480		
TOTAL HEPTA-DIOXINS	15.1	0.0703		
TOTAL TETRA-FURANS	2.89	0.0480		
TOTAL PENTA-FURANS	1.57	0.0480		
TOTAL HEXA-FURANS	2.13	0.0480		
TOTAL HEPTA-FURANS	1.40	0.0480		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	1.10
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	1.10

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	55.9
13C-1,2,3,7,8-PECDD	66.8
13C-1,2,3,6,7,8-HXCDD	65.0
13C-1,2,3,4,6,7,8-HPCDD	62.5
13C-OCDD	57.1
13C-2,3,7,8-TCDF	58.4
13C-1,2,3,7,8-PECDF	60.8
13C-1,2,3,4,7,8-HXCDF	64.0
13C-1,2,3,4,6,7,8-HPCDF	62.5

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist





**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE ID.:** 05VN-059  
**SAMPLE COLLECTION:** N/A  
**CLIENT NO.:** 2607

**AXYS FILE:** L7744-29

**REPORT DATE:** 26-May-2005  
**METHOD NO.:** AXYS METHOD MLA-017 Rev 09  
**EXTRACTION DATE:** 24-Apr-2005  
**INSTRUMENT:** HR GC/MS  
**ANALYSIS DATE:** 06-May-2005  
**CONCENTRATION IN:** pg/g (dry weight basis)

**SAMPLE TYPE:** SOIL  
**SAMPLE SIZE:** 11.1 g (dry)

**% Moisture:** 15.2

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	0.413	0.0450		
1,2,3,7,8-PECDD	0.126	0.0450		
1,2,3,4,7,8-HXCDD	0.181	0.0450		
1,2,3,6,7,8-HXCDD	0.698	0.0450		
1,2,3,7,8,9-HXCDD	0.637	0.0450		
1,2,3,4,6,7,8-HPCDD	13.4	0.0450		
OCDD	107	0.0477		
2,3,7,8-TCDF *	0.294	0.0450		
1,2,3,7,8-PECDF	0.185	0.0450		
2,3,4,7,8-PECDF	0.313	0.0450		
1,2,3,4,7,8-HXCDF	0.352	0.0450		
1,2,3,6,7,8-HXCDF	0.273	0.0450		
2,3,4,6,7,8-HXCDF	0.184	0.0450		
1,2,3,7,8,9-HXCDF	0.054	0.0450		
1,2,3,4,6,7,8-HPCDF	1.86	0.0450		
1,2,3,4,7,8,9-HPCDF	0.130	0.0450		
OCDF	2.73	0.0450		
TOTAL TETRA-DIOXINS	1.34	0.0450		
TOTAL PENTA-DIOXINS	1.45	0.0450		
TOTAL HEXA-DIOXINS	6.34	0.0450		
TOTAL HEPTA-DIOXINS	29.7	0.0450		
TOTAL TETRA-FURANS	2.96	0.0450		
TOTAL PENTA-FURANS	4.90	0.0450		
TOTAL HEXA-FURANS	5.45	0.0450	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEPTA-FURANS	4.29	0.0450	2,3,7,8-TCDD TEQs (ND=0) =	1.14
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	1.14

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	83.7
13C-1,2,3,7,8-PECDD	96.0
13C-1,2,3,6,7,8-HXCDD	89.4
13C-1,2,3,4,6,7,8-HPCDD	93.5
13C-OCDD	98.9
13C-2,3,7,8-TCDF	83.1
13C-1,2,3,7,8-PECDF	94.3
13C-1,2,3,4,7,8-HXCDF	96.9
13C-1,2,3,4,6,7,8-HPCDF	89.4

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

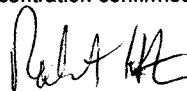
<b>CLIENT SAMPLE I.D.:</b>	05VN-060	<b>AXYS FILE:</b>	L8155-18 L
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	04-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	23-Sep-2005
<b>SAMPLE SIZE:</b>	9.93 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	28.1	<b>ANALYSIS DATE:</b>	28-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	0.748	0.0500		
1,2,3,7,8-PECDD	0.191	0.0500		
1,2,3,4,7,8-HXCDD	0.321	0.0500		
1,2,3,6,7,8-HXCDD	1.33	0.0500		
1,2,3,7,8,9-HXCDD	1.24	0.0500		
1,2,3,4,6,7,8-HPCDD	26.0	0.0593		
OCDD	195	0.0576		
2,3,7,8-TCDF *	0.586	0.0500		
1,2,3,7,8-PECDF	0.335	0.0500		
2,3,4,7,8-PECDF	0.492	0.0500		
1,2,3,4,7,8-HXCDF	0.623	0.0500		
1,2,3,6,7,8-HXCDF	0.590	0.0500		
2,3,4,6,7,8-HXCDF	0.365	0.0500		
1,2,3,7,8,9-HXCDF	0.114	0.0500		
1,2,3,4,6,7,8-HPCDF	3.19	0.0500		
1,2,3,4,7,8,9-HPCDF	0.181	0.0500		
OCDF	3.48	0.0500		
TOTAL TETRA-DIOXINS	1.99	0.0500		
TOTAL PENTA-DIOXINS	2.61	0.0500		
TOTAL HEXA-DIOXINS	11.8	0.0500		
TOTAL HEPTA-DIOXINS	55.3	0.0593		
TOTAL TETRA-FURANS	4.99	0.0500		
TOTAL PENTA-FURANS	8.92	0.0500		
TOTAL HEXA-FURANS	9.74	0.0500		
TOTAL HEPTA-FURANS	6.86	0.0500		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	2.03
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	2.03

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	63.0
13C-1,2,3,7,8-PECDD	71.8
13C-1,2,3,6,7,8-HXCDD	61.9
13C-1,2,3,4,6,7,8-HPCDD	58.0
13C-OCDD	49.0
13C-2,3,7,8-TCDF	58.0
13C-1,2,3,7,8-PECDF	68.1
13C-1,2,3,4,7,8-HXCDF	60.0
13C-1,2,3,4,6,7,8-HPCDF	59.5

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-061	<b>AXYS FILE:</b>	L8155-19
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	04-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	23-Sep-2005
<b>SAMPLE SIZE:</b>	10.1 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	12.4	<b>ANALYSIS DATE:</b>	09-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	4.47	0.0500		
1,2,3,7,8-PECDD	0.359	0.0500		
1,2,3,4,7,8-HXCDD	0.104	0.0506		
1,2,3,6,7,8-HXCDD	0.430	0.0506		
1,2,3,7,8,9-HXCDD	0.499	0.0506		
1,2,3,4,6,7,8-HPCDD	3.52	0.0823		
OCDD	29.7	0.179		
2,3,7,8-TCDF *	0.464	0.0500		
1,2,3,7,8-PECDF	0.128	0.0500		
2,3,4,7,8-PECDF	0.159	0.0500		
1,2,3,4,7,8-HXCDF	0.123	0.0500		
1,2,3,6,7,8-HXCDF	0.079	0.0500		
2,3,4,6,7,8-HXCDF	0.076	0.0500		
1,2,3,7,8,9-HXCDF	0.074	0.0500		
1,2,3,4,6,7,8-HPCDF	0.454	0.0500		
1,2,3,4,7,8,9-HPCDF	ND	0.0500		
OCDF	0.565	0.0500		
TOTAL TETRA-DIOXINS	5.93	0.0500		
TOTAL PENTA-DIOXINS	3.75	0.0500		
TOTAL HEXA-DIOXINS	7.37	0.0506		
TOTAL HEPTA-DIOXINS	7.69	0.0823		
TOTAL TETRA-FURANS	6.88	0.0500		
TOTAL PENTA-FURANS	2.29	0.0500	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEXA-FURANS	1.33	0.0500	2,3,7,8-TCDD TEQs (ND=0) =	5.14
TOTAL HEPTA-FURANS	0.834	0.0500	2,3,7,8-TCDD TEQs (ND=1/2 DL) =	5.14

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	48.4
13C-1,2,3,7,8-PECDD	59.1
13C-1,2,3,6,7,8-HXCDD	52.0
13C-1,2,3,4,6,7,8-HPCDD	52.9
13C-OCDD	44.1
13C-2,3,7,8-TCDF	49.3
13C-1,2,3,7,8-PECDF	54.7
13C-1,2,3,4,7,8-HXCDF	53.1
13C-1,2,3,4,6,7,8-HPCDF	49.4

1. SDL = Sample Detection Limit
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4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-062  
**SAMPLE COLLECTION:** N/A  
**CLIENT NO.:** 2607

**AXYS FILE:** L7744-30

**SAMPLE TYPE:** SEDIMENT  
**SAMPLE SIZE:** 11.8 g (dry)

**REPORT DATE:** 26-May-2005  
**METHOD NO.:** AXYS METHOD MLA-017 Rev 09  
**EXTRACTION DATE:** 24-Apr-2005  
**INSTRUMENT:** HR GC/MS  
**ANALYSIS DATE:** 06-May-2005  
**CONCENTRATION IN:** pg/g (dry weight basis)

**% Moisture:** 36.6

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	0.338	0.0420	
1,2,3,7,8-PECDD	0.218	0.0420	
1,2,3,4,7,8-HXCDD	0.210	0.0420	
1,2,3,6,7,8-HXCDD	0.793	0.0420	
1,2,3,7,8,9-HXCDD	1.10	0.0420	
1,2,3,4,6,7,8-HPCDD	6.83	0.0420	
OCDD	46.9	0.0420	
2,3,7,8-TCDF *	0.304	0.0420	
1,2,3,7,8-PECDF	0.247	0.0420	
2,3,4,7,8-PECDF	0.385	0.0420	
1,2,3,4,7,8-HXCDF	0.276	0.0420	
1,2,3,6,7,8-HXCDF	0.258	0.0420	
2,3,4,6,7,8-HXCDF	0.225	0.0420	
1,2,3,7,8,9-HXCDF	0.425	0.0420	
1,2,3,4,6,7,8-HPCDF	1.33	0.0420	
1,2,3,4,7,8,9-HPCDF	0.111	0.0420	
OCDF	1.98	0.0420	
TOTAL TETRA-DIOXINS	1.14	0.0420	
TOTAL PENTA-DIOXINS	1.85	0.0420	
TOTAL HEXA-DIOXINS	5.84	0.0420	
TOTAL HEPTA-DIOXINS	14.2	0.0420	
TOTAL TETRA-FURANS	4.54	0.0420	
TOTAL PENTA-FURANS	3.98	0.0420	
TOTAL HEXA-FURANS	3.36	0.0420	
TOTAL HEPTA-FURANS	2.40	0.0420	
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>
			2,3,7,8-TCDD TEQs (ND=0) = 1.21
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 1.21

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	75.5
13C-1,2,3,7,8-PECDD	83.5
13C-1,2,3,6,7,8-HXCDD	80.1
13C-1,2,3,4,6,7,8-HPCDD	83.7
13C-OCDD	73.5
13C-2,3,7,8-TCDF	75.9
13C-1,2,3,7,8-PECDF	82.4
13C-1,2,3,4,7,8-HXCDF	87.7
13C-1,2,3,4,6,7,8-HPCDF	80.1

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



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## **Appendix A4.4**

### **Dioxin Data: Nha Trang**

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**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-064	<b>AXYS FILE:</b>	L7744-32
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	14-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	28-Apr-2005
<b>SAMPLE SIZE:</b>	10.3 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	7.90	<b>ANALYSIS DATE:</b>	15-May-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	5.11	0.0486	
1,2,3,7,8-PECDD	15.3	0.0489	
1,2,3,4,7,8-HXCDD	21.9	0.246	
1,2,3,6,7,8-HXCDD	75.9	0.246	
1,2,3,7,8,9-HXCDD	46.6	0.246	
1,2,3,4,6,7,8-HPCDD	2100	0.623	
OCDD	18200	0.390	
2,3,7,8-TCDF *	6.53	0.0490	
1,2,3,7,8-PECDF	5.01	0.0486	
2,3,4,7,8-PECDF	8.42	0.0486	
1,2,3,4,7,8-HXCDF	20.8	0.112	
1,2,3,6,7,8-HXCDF	13.6	0.112	
2,3,4,6,7,8-HXCDF	10.8	0.112	
1,2,3,7,8,9-HXCDF	0.785	0.112	
1,2,3,4,6,7,8-HPCDF	291	0.157	
1,2,3,4,7,8,9-HPCDF	16.4	0.157	
OCDF	688	0.0589	
TOTAL TETRA-DIOXINS	23.5	0.0486	
TOTAL PENTA-DIOXINS	91.2	0.0489	
TOTAL HEXA-DIOXINS	524	0.246	
TOTAL HEPTA-DIOXINS	3930	0.623	
TOTAL TETRA-FURANS	64.7	0.0899	
TOTAL PENTA-FURANS	143	0.0486	
TOTAL HEXA-FURANS	463	0.112	
TOTAL HEPTA-FURANS	1090	0.157	
		<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
		2,3,7,8-TCDD TEQs (ND=0) =	70.5
		2,3,7,8-TCDD TEQs (ND=1/2 DL) =	70.5

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	81.2
13C-1,2,3,7,8-PECDD	86.2
13C-1,2,3,6,7,8-HXCDD	77.9
13C-1,2,3,4,6,7,8-HPCDD	74.6
13C-OCDD	85.4
13C-2,3,7,8-TCDF	78.6
13C-1,2,3,7,8-PECDF	77.9
13C-1,2,3,4,7,8-HXCDF	78.2
13C-1,2,3,4,6,7,8-HPCDF	65.7

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*Robert H*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

CLIENT SAMPLE I.D.:	05VN-065	AXYS FILE:	L8155-20
SAMPLE COLLECTION:	N/A		
CLIENT NO.:	2607	REPORT DATE:	04-Nov-2005
		METHOD NO.:	AXYS METHOD MLA-017 Rev 10
SAMPLE TYPE:	SOIL	EXTRACTION DATE:	23-Sep-2005
SAMPLE SIZE:	10.4 g (dry)	INSTRUMENT:	HR GC/MS
		ANALYSIS DATE:	09-Oct-2005
% Moisture:	0.39	CONCENTRATION IN:	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	28.4	0.0480		
1,2,3,7,8-PECDD	1.16	0.0480		
1,2,3,4,7,8-HXCDD	1.87	0.0622		
1,2,3,6,7,8-HXCDD	5.82	0.0622		
1,2,3,7,8,9-HXCDD	4.60	0.0622		
1,2,3,4,6,7,8-HPCDD	131	0.149		
OCDD	984	0.0866		
2,3,7,8-TCDF *	0.591	0.0480		
1,2,3,7,8-PECDF	0.463	0.0480		
2,3,4,7,8-PECDF	0.551	0.0480		
1,2,3,4,7,8-HXCDF	1.42	0.0480		
1,2,3,6,7,8-HXCDF	1.30	0.0480		
2,3,4,6,7,8-HXCDF	0.886	0.0480		
1,2,3,7,8,9-HXCDF	0.134	0.0480		
1,2,3,4,6,7,8-HPCDF	15.3	0.0480		
1,2,3,4,7,8,9-HPCDF	0.868	0.0480		
OCDF	17.9	0.0480		
TOTAL TETRA-DIOXINS	30.7	0.0480		
TOTAL PENTA-DIOXINS	7.84	0.0480		
TOTAL HEXA-DIOXINS	48.9	0.0622		
TOTAL HEPTA-DIOXINS	277	0.149		
TOTAL TETRA-FURANS	5.17	0.0480		
TOTAL PENTA-FURANS	14.0	0.0480		
TOTAL HEXA-FURANS	26.4	0.0480		
TOTAL HEPTA-FURANS	32.0	0.0480		
			2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
			2,3,7,8-TCDD TEQs (ND=0) =	33.1
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	33.1

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	41.5
13C-1,2,3,7,8-PECDD	61.8
13C-1,2,3,6,7,8-HXCDD	61.7
13C-1,2,3,4,6,7,8-HPCDD	63.0
13C-OCDD	53.3
13C-2,3,7,8-TCDF	41.0
13C-1,2,3,7,8-PECDF	54.3
13C-1,2,3,4,7,8-HXCDF	61.1
13C-1,2,3,4,6,7,8-HPCDF	61.4

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-066	<b>AXYS FILE:</b>	L8155-21 L
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	04-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	23-Sep-2005
<b>SAMPLE SIZE:</b>	10.1 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	8.20	<b>ANALYSIS DATE:</b>	28-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

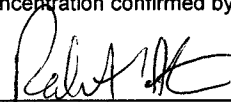
COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	4.29	0.0490	
1,2,3,7,8-PECDD	2.08	0.0490	
1,2,3,4,7,8-HXCDD	3.72	0.0700	
1,2,3,6,7,8-HXCDD	13.2	0.0701	
1,2,3,7,8,9-HXCDD	9.26	0.0700	
1,2,3,4,6,7,8-HPCDD	344	0.109	
OCDD	3640	0.0948	
2,3,7,8-TCDF *	1.18	0.0490	
1,2,3,7,8-PECDF	1.12	0.0880	
2,3,4,7,8-PECDF	1.71	0.0880	
1,2,3,4,7,8-HXCDF	4.78	0.0490	
1,2,3,6,7,8-HXCDF	3.39	0.0490	
2,3,4,6,7,8-HXCDF	2.10	0.0490	
1,2,3,7,8,9-HXCDF	0.156	0.0490	
1,2,3,4,6,7,8-HPCDF	43.9	0.0490	
1,2,3,4,7,8,9-HPCDF	2.51	0.0490	
OCDF	63.1	0.0490	
TOTAL TETRA-DIOXINS	6.02	0.0490	
TOTAL PENTA-DIOXINS	9.47	0.0490	
TOTAL HEXA-DIOXINS	89.6	0.0700	
TOTAL HEPTA-DIOXINS	702	0.109	
TOTAL TETRA-FURANS	10.8	0.0490	
TOTAL PENTA-FURANS	34.5	0.0880	
TOTAL HEXA-FURANS	76.9	0.0490	
TOTAL HEPTA-FURANS	107	0.0490	
			2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)
			2,3,7,8-TCDD TEQs (ND=0) = 15.3
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 15.3

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	75.9
13C-1,2,3,7,8-PECDD	92.2
13C-1,2,3,6,7,8-HXCDD	84.2
13C-1,2,3,4,6,7,8-HPCDD	76.5
13C-OCDD	66.6
13C-2,3,7,8-TCDF	73.1
13C-1,2,3,7,8-PECDF	83.4
13C-1,2,3,4,7,8-HXCDF	83.3
13C-1,2,3,4,6,7,8-HPCDF	76.2

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-067

**SAMPLE COLLECTION:** N/A

**CLIENT NO.:** 2607

**SAMPLE TYPE:** SEDIMENT

**SAMPLE SIZE:** 11.0 g (dry)

**% Moisture:** 37.9

**AXYS FILE:** L7744-33

**REPORT DATE:** 14-Jun-2005

**METHOD NO.:** AXYS METHOD MLA-017 Rev 09

**EXTRACTION DATE:** 28-Apr-2005

**INSTRUMENT:** HR GC/MS

**ANALYSIS DATE:** 15-May-2005

**CONCENTRATION IN:** pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	1.40	0.0453		
1,2,3,7,8-PECDD	1.94	0.0556		
1,2,3,4,7,8-HXCDD	3.70	0.164		
1,2,3,6,7,8-HXCDD	11.9	0.164		
1,2,3,7,8,9-HXCDD	8.63	0.164		
1,2,3,4,6,7,8-HPCDD	518	0.157		
OCDD	5060	0.212		
2,3,7,8-TCDF *	0.970	0.0450		
1,2,3,7,8-PECDF	1.16	0.0518		
2,3,4,7,8-PECDF	1.70	0.0518		
1,2,3,4,7,8-HXCDF	4.14	0.0739		
1,2,3,6,7,8-HXCDF	1.94	0.0739		
2,3,4,6,7,8-HXCDF	1.68	0.0739		
1,2,3,7,8,9-HXCDF	NDR (0.193)	0.0739		
1,2,3,4,6,7,8-HPCDF	26.9	0.0597		
1,2,3,4,7,8,9-HPCDF	1.58	0.0597		
OCDF	31.5	0.0584		
TOTAL TETRA-DIOXINS	9.25	0.0453		
TOTAL PENTA-DIOXINS	12.2	0.0556		
TOTAL HEXA-DIOXINS	114	0.164		
TOTAL HEPTA-DIOXINS	1300	0.157		
TOTAL TETRA-FURANS	11.9	0.0506		
TOTAL PENTA-FURANS	25.3	0.0518		
TOTAL HEXA-FURANS	58.9	0.0739		
TOTAL HEPTA-FURANS	71.1	0.0597		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	13.5
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	13.5

**Surrogate Standards**

**% Recovery**

13C-2,3,7,8-TCDD	66.5
13C-1,2,3,7,8-PECDD	67.9
13C-1,2,3,6,7,8-HXCDD	67.7
13C-1,2,3,4,6,7,8-HPCDD	63.3
13C-OCDD	70.2
13C-2,3,7,8-TCDF	65.6
13C-1,2,3,7,8-PECDF	64.1
13C-1,2,3,4,7,8-HXCDF	65.9
13C-1,2,3,4,6,7,8-HPCDF	60.4

1. SDL = Sample Detection Limit
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4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



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## **Appendix A4.5**

### **Dioxin Data: Bien Hoa**

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**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	04VN-011	<b>AXYS FILE:</b>	L7508-3 RX
<b>SAMPLE COLLECTION:</b>	10-Mar-2004	<b>REPORT DATE:</b>	26-May-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	18-Jan-2005
<b>SAMPLE SIZE:</b>	5.51 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	31.2	<b>ANALYSIS DATE:</b>	10-Mar-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	0.304	0.0910	
1,2,3,7,8-PECDD	0.249	0.0910	
1,2,3,4,7,8-HXCDD	0.304	0.0910	
1,2,3,6,7,8-HXCDD	0.660	0.0910	
1,2,3,7,8,9-HXCDD	0.775	0.0910	
1,2,3,4,6,7,8-HPCDD	13.1	0.0910	
OCDD	102	0.0910	
2,3,7,8-TCDF *	0.184	0.0910	
1,2,3,7,8-PECDF	0.238	0.0910	
2,3,4,7,8-PECDF	0.317	0.0910	
1,2,3,4,7,8-HXCDF	0.370	0.0910	
1,2,3,6,7,8-HXCDF	0.280	0.0910	
2,3,4,6,7,8-HXCDF	0.238	0.0910	
1,2,3,7,8,9-HXCDF	0.162	0.0910	
1,2,3,4,6,7,8-HPCDF	2.12	0.0910	
1,2,3,4,7,8,9-HPCDF	0.230	0.0910	
OCDF	3.13	0.0910	
TOTAL TETRA-DIOXINS	0.858	0.0910	
TOTAL PENTA-DIOXINS	1.36	0.0910	
TOTAL HEXA-DIOXINS	6.11	0.0910	
TOTAL HEPTA-DIOXINS	26.6	0.0910	
TOTAL TETRA-FURANS	1.98	0.0910	
TOTAL PENTA-FURANS	2.25	0.0910	
TOTAL HEXA-FURANS	3.29	0.0910	
TOTAL HEPTA-FURANS	4.57	0.0910	
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>
			2,3,7,8-TCDD TEQs (ND=0) = 1.19
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 1.19

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	87.8
13C-1,2,3,7,8-PECDD	94.7
13C-1,2,3,6,7,8-HXCDD	91.9
13C-1,2,3,4,6,7,8-HPCDD	89.4
13C-OCDD	83.6
13C-2,3,7,8-TCDF	83.6
13C-1,2,3,7,8-PECDF	89.9
13C-1,2,3,4,7,8-HXCDF	89.3
13C-1,2,3,4,6,7,8-HPCDF	84.9

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
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5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*[Signature]*

QA/QC Chemist





**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	04VN-013	<b>AXYS FILE:</b>	L7508-4 RX
<b>SAMPLE COLLECTION:</b>	10-Mar-2004	<b>REPORT DATE:</b>	26-May-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	18-Jan-2005
<b>SAMPLE SIZE:</b>	5.21 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	5.31	<b>ANALYSIS DATE:</b>	10-Mar-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	12.2	0.0960	
1,2,3,7,8-PECDD	0.897	0.0960	
1,2,3,4,7,8-HXCDD	0.430	0.0960	
1,2,3,6,7,8-HXCDD	1.32	0.0960	
1,2,3,7,8,9-HXCDD	2.19	0.0960	
1,2,3,4,6,7,8-HPCDD	23.8	0.0960	
OCDD	604	0.0960	
2,3,7,8-TCDF *	1.63	0.0960	
1,2,3,7,8-PECDF	0.453	0.100	
2,3,4,7,8-PECDF	0.364	0.101	
1,2,3,4,7,8-HXCDF	0.342	0.0960	
1,2,3,6,7,8-HXCDF	0.357	0.0960	
2,3,4,6,7,8-HXCDF	0.264	0.0960	
1,2,3,7,8,9-HXCDF	0.404	0.0960	
1,2,3,4,6,7,8-HPCDF	1.90	0.0960	
1,2,3,4,7,8,9-HPCDF	0.170	0.0960	
OCDF	1.92	0.0960	
TOTAL TETRA-DIOXINS	17.4	0.0960	
TOTAL PENTA-DIOXINS	7.81	0.0960	
TOTAL HEXA-DIOXINS	17.0	0.0960	
TOTAL HEPTA-DIOXINS	58.7	0.0960	
TOTAL TETRA-FURANS	17.1	0.120	
TOTAL PENTA-FURANS	6.99	0.100	
TOTAL HEXA-FURANS	4.30	0.0960	
TOTAL HEPTA-FURANS	3.45	0.0960	
		<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
		2,3,7,8-TCDD TEQs (ND=0) =	14.3
		2,3,7,8-TCDD TEQs (ND=1/2 DL) =	14.3

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	93.2
13C-1,2,3,7,8-PECDD	96.0
13C-1,2,3,6,7,8-HXCDD	96.2
13C-1,2,3,4,6,7,8-HPCDD	90.5
13C-OCDD	84.4
13C-2,3,7,8-TCDF	88.3
13C-1,2,3,7,8-PECDF	93.9
13C-1,2,3,4,7,8-HXCDF	91.7
13C-1,2,3,4,6,7,8-HPCDF	90.1

1. SDL = Sample Detection Limit
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Approved: \_\_\_\_\_

*[Signature]*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	04VN-014	<b>AXYS FILE:</b>	L7508-5 RX
<b>SAMPLE COLLECTION:</b>	10-Mar-2004	<b>REPORT DATE:</b>	26-May-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	18-Jan-2005
<b>SAMPLE SIZE:</b>	5.26 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	31.3	<b>ANALYSIS DATE:</b>	10-Mar-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	96.7	0.0950	
1,2,3,7,8-PECDD	2.20	0.0950	
1,2,3,4,7,8-HXCDD	1.49	0.150	
1,2,3,6,7,8-HXCDD	6.67	0.150	
1,2,3,7,8,9-HXCDD	5.87	0.150	
1,2,3,4,6,7,8-HPCDD	204	0.254	
OCDD	1990	0.569	
2,3,7,8-TCDF *	17.1	0.0950	
1,2,3,7,8-PECDF	1.14	0.100	
2,3,4,7,8-PECDF	0.780	0.100	
1,2,3,4,7,8-HXCDF	1.31	0.120	
1,2,3,6,7,8-HXCDF	2.67	0.120	
2,3,4,6,7,8-HXCDF	1.01	0.120	
1,2,3,7,8,9-HXCDF	1.63	0.122	
1,2,3,4,6,7,8-HPCDF	27.4	0.0950	
1,2,3,4,7,8,9-HPCDF	2.05	0.0950	
OCDF	103	0.0950	
TOTAL TETRA-DIOXINS	119	0.0950	
TOTAL PENTA-DIOXINS	21.5	0.0950	
TOTAL HEXA-DIOXINS	65.8	0.150	
TOTAL HEPTA-DIOXINS	411	0.254	
TOTAL TETRA-FURANS	57.8	0.272	
TOTAL PENTA-FURANS	37.8	0.100	
TOTAL HEXA-FURANS	35.8	0.120	
TOTAL HEPTA-FURANS	90.7	0.0950	
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>
			2,3,7,8-TCDD TEQs (ND=0) = 106
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 106

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	103
13C-1,2,3,7,8-PECDD	105
13C-1,2,3,6,7,8-HXCDD	95.6
13C-1,2,3,4,6,7,8-HPCDD	97.8
13C-OCDD	96.8
13C-2,3,7,8-TCDF	97.8
13C-1,2,3,7,8-PECDF	98.7
13C-1,2,3,4,7,8-HXCDF	95.4
13C-1,2,3,4,6,7,8-HPCDF	95.1

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5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*[Signature]*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

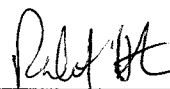
<b>CLIENT SAMPLE I.D.:</b>	05VN-073	<b>AXYS FILE:</b>	L8155-22
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	04-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	23-Sep-2005
<b>SAMPLE SIZE:</b>	10.7 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	37.4	<b>ANALYSIS DATE:</b>	09-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	18.8	0.0470		
1,2,3,7,8-PECDD	1.92	0.0470		
1,2,3,4,7,8-HXCDD	0.737	0.0759		
1,2,3,6,7,8-HXCDD	2.22	0.0759		
1,2,3,7,8,9-HXCDD	3.40	0.0759		
1,2,3,4,6,7,8-HPCDD	46.4	0.108		
OCDD	676	0.118		
2,3,7,8-TCDF *	3.29	0.0470		
1,2,3,7,8-PECDF	0.420	0.0470		
2,3,4,7,8-PECDF	0.374	0.0470		
1,2,3,4,7,8-HXCDF	0.458	0.0470		
1,2,3,6,7,8-HXCDF	0.538	0.0470		
2,3,4,6,7,8-HXCDF	0.347	0.0470		
1,2,3,7,8,9-HXCDF	0.448	0.0470		
1,2,3,4,6,7,8-HPCDF	4.07	0.0470		
1,2,3,4,7,8,9-HPCDF	0.315	0.0470		
OCDF	7.07	0.0470		
TOTAL TETRA-DIOXINS	30.0	0.0470		
TOTAL PENTA-DIOXINS	16.4	0.0470		
TOTAL HEXA-DIOXINS	31.6	0.0759		
TOTAL HEPTA-DIOXINS	104	0.108		
TOTAL TETRA-FURANS	17.8	0.0557		
TOTAL PENTA-FURANS	12.0	0.0470		
TOTAL HEXA-FURANS	8.81	0.0470		
TOTAL HEPTA-FURANS	9.48	0.0470		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	22.6
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	22.6

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	75.1
13C-1,2,3,7,8-PECDD	87.7
13C-1,2,3,6,7,8-HXCDD	79.6
13C-1,2,3,4,6,7,8-HPCDD	76.5
13C-OCDD	60.9
13C-2,3,7,8-TCDF	75.3
13C-1,2,3,7,8-PECDF	79.8
13C-1,2,3,4,7,8-HXCDF	73.4
13C-1,2,3,4,6,7,8-HPCDF	71.9

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

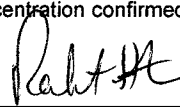
<b>CLIENT SAMPLE I.D.:</b>	05VN-074	<b>AXYS FILE:</b>	L8155-23
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	04-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	23-Sep-2005
<b>SAMPLE SIZE:</b>	11.3 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	39.3	<b>ANALYSIS DATE:</b>	09-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	279	0.0440	
1,2,3,7,8-PECDD	2.63	0.0440	
1,2,3,4,7,8-HXCDD	1.45	0.115	
1,2,3,6,7,8-HXCDD	4.18	0.115	
1,2,3,7,8,9-HXCDD	4.94	0.115	
1,2,3,4,6,7,8-HPCDD	108	0.123	
OCDD	620	0.109	
2,3,7,8-TCDF *	26.5	0.0440	
1,2,3,7,8-PECDF	1.02	0.0779	
2,3,4,7,8-PECDF	0.747	0.0779	
1,2,3,4,7,8-HXCDF	1.01	0.0440	
1,2,3,6,7,8-HXCDF	2.78	0.0440	
2,3,4,6,7,8-HXCDF	0.609	0.0440	
1,2,3,7,8,9-HXCDF	0.443	0.0440	
1,2,3,4,6,7,8-HPCDF	8.76	0.0616	
1,2,3,4,7,8,9-HPCDF	0.928	0.0616	
OCDF	16.0	0.0440	
TOTAL TETRA-DIOXINS	311	0.0440	
TOTAL PENTA-DIOXINS	26.5	0.0440	
TOTAL HEXA-DIOXINS	60.1	0.115	
TOTAL HEPTA-DIOXINS	205	0.123	
TOTAL TETRA-FURANS	111	0.311	
TOTAL PENTA-FURANS	89.8	0.0779	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)
TOTAL HEXA-FURANS	28.3	0.0440	2,3,7,8-TCDD TEQs (ND=0) = 287
TOTAL HEPTA-FURANS	23.2	0.0616	2,3,7,8-TCDD TEQs (ND=1/2 DL) = 287

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	39.0
13C-1,2,3,7,8-PECDD	43.9
13C-1,2,3,6,7,8-HXCDD	42.5
13C-1,2,3,4,6,7,8-HPCDD	40.7
13C-OCDD	30.0
13C-2,3,7,8-TCDF	39.2
13C-1,2,3,7,8-PECDF	40.5
13C-1,2,3,4,7,8-HXCDF	40.8
13C-1,2,3,4,6,7,8-HPCDF	37.9

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-077	<b>AXYS FILE:</b>	L8155-24
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	04-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	23-Sep-2005
<b>SAMPLE SIZE:</b>	10.1 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	30.3	<b>ANALYSIS DATE:</b>	09-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	27.1	0.0490		
1,2,3,7,8-PECDD	1.78	0.0490		
1,2,3,4,7,8-HXCDD	1.84	0.117		
1,2,3,6,7,8-HXCDD	4.71	0.117		
1,2,3,7,8,9-HXCDD	6.24	0.117		
1,2,3,4,6,7,8-HPCDD	74.8	0.0830		
OCDD	634	0.128		
2,3,7,8-TCDF *	8.93	0.101		
1,2,3,7,8-PECDF	4.54	0.313		
2,3,4,7,8-PECDF	6.12	0.313		
1,2,3,4,7,8-HXCDF	11.3	0.143		
1,2,3,6,7,8-HXCDF	11.6	0.143		
2,3,4,6,7,8-HXCDF	12.0	0.143		
1,2,3,7,8,9-HXCDF	1.05	0.143		
1,2,3,4,6,7,8-HPCDF	57.5	0.0953		
1,2,3,4,7,8,9-HPCDF	5.43	0.0953		
OCDF	41.9	0.0490		
TOTAL TETRA-DIOXINS	45.0	0.0490		
TOTAL PENTA-DIOXINS	27.1	0.0490		
TOTAL HEXA-DIOXINS	60.4	0.117		
TOTAL HEPTA-DIOXINS	159	0.0830		
TOTAL TETRA-FURANS	92.4	0.844		
TOTAL PENTA-FURANS	97.9	0.313	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEXA-FURANS	111	0.143	2,3,7,8-TCDD TEQs (ND=0) =	39.4
TOTAL HEPTA-FURANS	90.4	0.0953	2,3,7,8-TCDD TEQs (ND=1/2 DL) =	39.4

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	51.8
13C-1,2,3,7,8-PECDD	55.0
13C-1,2,3,6,7,8-HXCDD	56.0
13C-1,2,3,4,6,7,8-HPCDD	56.1
13C-OCDD	50.3
13C-2,3,7,8-TCDF	53.5
13C-1,2,3,7,8-PECDF	54.0
13C-1,2,3,4,7,8-HXCDF	57.1
13C-1,2,3,4,6,7,8-HPCDF	56.2

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5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-078	<b>AXYS FILE:</b>	L7744-34
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	26-May-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	24-Apr-2005
<b>SAMPLE SIZE:</b>	9.99 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
		<b>ANALYSIS DATE:</b>	06-May-2005
<b>% Moisture:</b>	58.6	<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	797	0.0500		
1,2,3,7,8-PECDD	21.8	0.0500		
1,2,3,4,7,8-HXCDD	3.78	0.240		
1,2,3,6,7,8-HXCDD	18.1	0.240		
1,2,3,7,8,9-HXCDD	11.5	0.240		
1,2,3,4,6,7,8-HPCDD	239	0.101		
OCDD	1670	0.178		
2,3,7,8-TCDF *	52.3	0.0500		
1,2,3,7,8-PECDF	2.10	0.140		
2,3,4,7,8-PECDF	3.00	0.140		
1,2,3,4,7,8-HXCDF	3.41	0.0500		
1,2,3,6,7,8-HXCDF	3.74	0.0500		
2,3,4,6,7,8-HXCDF	1.91	0.0500		
1,2,3,7,8,9-HXCDF	0.643	0.0500		
1,2,3,4,6,7,8-HPCDF	36.0	0.0780		
1,2,3,4,7,8,9-HPCDF	2.49	0.0780		
OCDF	73.2	0.0500		
TOTAL TETRA-DIOXINS	866	0.0500		
TOTAL PENTA-DIOXINS	111	0.0500		
TOTAL HEXA-DIOXINS	174	0.240		
TOTAL HEPTA-DIOXINS	467	0.100		
TOTAL TETRA-FURANS	202	0.490		
TOTAL PENTA-FURANS	224	0.140		
TOTAL HEXA-FURANS	81.8	0.0500	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEPTA-FURANS	89.3	0.0780	2,3,7,8-TCDD TEQs (ND=0) =	833
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	833

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	83.6
13C-1,2,3,7,8-PECDD	85.7
13C-1,2,3,6,7,8-HXCDD	78.4
13C-1,2,3,4,6,7,8-HPCDD	76.0
13C-OCDD	64.2
13C-2,3,7,8-TCDF	81.0
13C-1,2,3,7,8-PECDF	85.1
13C-1,2,3,4,7,8-HXCDF	83.2
13C-1,2,3,4,6,7,8-HPCDF	73.3

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5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist





**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

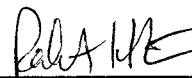
<b>CLIENT SAMPLE I.D.:</b>	05VN-079	<b>AXYS FILE:</b>	L8155-25
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	04-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	23-Sep-2005
<b>SAMPLE SIZE:</b>	10.5 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
		<b>ANALYSIS DATE:</b>	09-Oct-2005
<b>% Moisture:</b>	38.2	<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	224	0.0470		
1,2,3,7,8-PECDD	6.04	0.0470		
1,2,3,4,7,8-HXCDD	1.09	0.0741		
1,2,3,6,7,8-HXCDD	4.73	0.0741		
1,2,3,7,8,9-HXCDD	3.03	0.0741		
1,2,3,4,6,7,8-HPCDD	68.5	0.103		
OCDD	487	0.158		
2,3,7,8-TCDF *	15.0	0.0470		
1,2,3,7,8-PECDF	0.687	0.0785		
2,3,4,7,8-PECDF	0.993	0.0785		
1,2,3,4,7,8-HXCDF	1.29	0.0470		
1,2,3,6,7,8-HXCDF	1.17	0.0470		
2,3,4,6,7,8-HXCDF	0.766	0.0470		
1,2,3,7,8,9-HXCDF	0.203	0.0470		
1,2,3,4,6,7,8-HPCDF	12.8	0.0585		
1,2,3,4,7,8,9-HPCDF	1.07	0.0585		
OCDF	34.5	0.0470		
TOTAL TETRA-DIOXINS	247	0.0470		
TOTAL PENTA-DIOXINS	30.7	0.0470		
TOTAL HEXA-DIOXINS	47.2	0.0741		
TOTAL HEPTA-DIOXINS	134	0.103		
TOTAL TETRA-FURANS	58.5	0.319		
TOTAL PENTA-FURANS	65.1	0.0785	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEXA-FURANS	26.2	0.0470	2,3,7,8-TCDD TEQs (ND=0) =	234
TOTAL HEPTA-FURANS	34.2	0.0585	2,3,7,8-TCDD TEQs (ND=1/2 DL) =	234

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	63.7
13C-1,2,3,7,8-PECDD	71.5
13C-1,2,3,6,7,8-HXCDD	70.2
13C-1,2,3,4,6,7,8-HPCDD	61.5
13C-OCDD	39.9
13C-2,3,7,8-TCDF	62.9
13C-1,2,3,7,8-PECDF	64.9
13C-1,2,3,4,7,8-HXCDF	65.1
13C-1,2,3,4,6,7,8-HPCDF	56.4

1. SDL = Sample Detection Limit
2. ND = Not detected
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4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

CLIENT SAMPLE I.D.: 05VN-080  
SAMPLE COLLECTION: N/A  
CLIENT NO.: 2607

SAMPLE TYPE: SOIL  
SAMPLE SIZE: 11.3 g (dry)

% Moisture: 18.3

AXYS FILE: L7744-35 Ri

REPORT DATE: 08-Jun-2005  
METHOD NO.: AXYS METHOD MLA-017 Rev 09  
EXTRACTION DATE: 12-May-2005  
INSTRUMENT: HR GC/MS  
ANALYSIS DATE: 02-Jun-2005  
CONCENTRATION IN: pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)
2,3,7,8-TCDD	284	0.0440
1,2,3,7,8-PECDD	6.79	0.0440
1,2,3,4,7,8-HXCDD	1.04	0.0480
1,2,3,6,7,8-HXCDD	4.78	0.0480
1,2,3,7,8,9-HXCDD	3.13	0.0480
1,2,3,4,6,7,8-HPCDD	42.8	0.0572
OCDD	244	1.36
2,3,7,8-TCDF *	9.50	0.0440
1,2,3,7,8-PECDF	0.559	0.0460
2,3,4,7,8-PECDF	0.798	0.0463
1,2,3,4,7,8-HXCDF	0.853	0.0440
1,2,3,6,7,8-HXCDF	0.534	0.0440
2,3,4,6,7,8-HXCDF	0.387	0.0440
1,2,3,7,8,9-HXCDF	0.235	0.0440
1,2,3,4,6,7,8-HPCDF	6.48	0.0440
1,2,3,4,7,8,9-HPCDF	0.424	0.0440
OCDF	11.7	0.0308
TOTAL TETRA-DIOXINS	308	0.0440
TOTAL PENTA-DIOXINS	34.7	0.0440
TOTAL HEXA-DIOXINS	48.6	0.0480
TOTAL HEPTA-DIOXINS	82.8	0.0572
TOTAL TETRA-FURANS	67.3	0.262
TOTAL PENTA-FURANS	65.9	0.0460
TOTAL HEXA-FURANS	18.3	0.0440
TOTAL HEPTA-FURANS	14.6	0.0440

**2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)**

2,3,7,8-TCDD TEQs (ND=0) = 294  
2,3,7,8-TCDD TEQs (ND=1/2 DL) = 294

**Surrogate Standards % Recovery**

13C-2,3,7,8-TCDD	81.1
13C-1,2,3,7,8-PECDD	82.0
13C-1,2,3,6,7,8-HXCDD	78.3
13C-1,2,3,4,6,7,8-HPCDD	77.2
13C-OCDD	72.7
13C-2,3,7,8-TCDF	82.8
13C-1,2,3,7,8-PECDF	79.4
13C-1,2,3,4,7,8-HXCDF	83.5
13C-1,2,3,4,6,7,8-HPCDF	75.3

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5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-081  
**SAMPLE COLLECTION:** N/A  
**CLIENT NO.:** 2607

**SAMPLE TYPE:** SEDIMENT  
**SAMPLE SIZE:** 11.6 g (dry)

**% Moisture:** 9.99

**AXYS FILE:** L7744-36 R

**REPORT DATE:** 08-Jun-2005  
**METHOD NO.:** AXYS METHOD MLA-017 Rev 09  
**EXTRACTION DATE:** 12-May-2005  
**INSTRUMENT:** HR GC/MS  
**ANALYSIS DATE:** 23-May-2005  
**CONCENTRATION IN:** pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)
2,3,7,8-TCDD	76.9	0.0430
1,2,3,7,8-PECDD	1.92	0.0430
1,2,3,4,7,8-HXCDD	0.504	0.0510
1,2,3,6,7,8-HXCDD	1.81	0.0510
1,2,3,7,8,9-HXCDD	1.37	0.0510
1,2,3,4,6,7,8-HPCDD	22.6	0.0645
OCDD	178	0.284
2,3,7,8-TCDF *	4.51	0.0430
1,2,3,7,8-PECDF	0.263	0.0430
2,3,4,7,8-PECDF	0.419	0.0430
1,2,3,4,7,8-HXCDF	0.479	0.0430
1,2,3,6,7,8-HXCDF	0.400	0.0430
2,3,4,6,7,8-HXCDF	0.273	0.0430
1,2,3,7,8,9-HXCDF	0.121	0.0430
1,2,3,4,6,7,8-HPCDF	3.48	0.0510
1,2,3,4,7,8,9-HPCDF	NDR (0.189)	0.0510
OCDF	6.36	0.0498
TOTAL TETRA-DIOXINS	84.6	0.0430
TOTAL PENTA-DIOXINS	11.1	0.0430
TOTAL HEXA-DIOXINS	16.6	0.0510
TOTAL HEPTA-DIOXINS	43.5	0.0645
TOTAL TETRA-FURANS	26.0	0.0736
TOTAL PENTA-FURANS	25.6	0.0430
TOTAL HEXA-FURANS	9.21	0.0430
TOTAL HEPTA-FURANS	8.19	0.0510

**2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)**

2,3,7,8-TCDD TEQs (ND=0) = 80.3  
2,3,7,8-TCDD TEQs (ND=1/2 DL) = 80.3

**Surrogate Standards % Recovery**

13C-2,3,7,8-TCDD	68.9
13C-1,2,3,7,8-PECDD	75.4
13C-1,2,3,6,7,8-HXCDD	76.8
13C-1,2,3,4,6,7,8-HPCDD	83.0
13C-OCDD	79.4
13C-2,3,7,8-TCDF	73.8
13C-1,2,3,7,8-PECDF	72.3
13C-1,2,3,4,7,8-HXCDF	74.7
13C-1,2,3,4,6,7,8-HPCDF	81.1

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Approved: \_\_\_\_\_

*P. K. H.*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-085	<b>AXYS FILE:</b>	L8155-26
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	04-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	23-Sep-2005
<b>SAMPLE SIZE:</b>	9.90 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
		<b>ANALYSIS DATE:</b>	09-Oct-2005
<b>% Moisture:</b>	29.9	<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

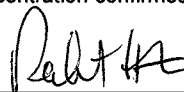
COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	41.5	0.0510		
1,2,3,7,8-PECDD	1.80	0.0510		
1,2,3,4,7,8-HXCDD	1.85	0.142		
1,2,3,6,7,8-HXCDD	6.50	0.142		
1,2,3,7,8,9-HXCDD	5.38	0.142		
1,2,3,4,6,7,8-HPCDD	154	0.217		
OCDD	1300	0.121		
2,3,7,8-TCDF *	2.89	0.0510		
1,2,3,7,8-PECDF	1.29	0.0521		
2,3,4,7,8-PECDF	1.12	0.0521		
1,2,3,4,7,8-HXCDF	3.03	0.0510		
1,2,3,6,7,8-HXCDF	1.97	0.0510		
2,3,4,6,7,8-HXCDF	1.33	0.0510		
1,2,3,7,8,9-HXCDF	0.993	0.0510		
1,2,3,4,6,7,8-HPCDF	24.3	0.0685		
1,2,3,4,7,8,9-HPCDF	1.90	0.0685		
OCDF	39.8	0.0510		
TOTAL TETRA-DIOXINS	55.5	0.0510		
TOTAL PENTA-DIOXINS	16.8	0.0510		
TOTAL HEXA-DIOXINS	56.3	0.142		
TOTAL HEPTA-DIOXINS	327	0.217		
TOTAL TETRA-FURANS	26.2	0.109		
TOTAL PENTA-FURANS	34.7	0.0521	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEXA-FURANS	48.8	0.0510	2,3,7,8-TCDD TEQs (ND=0) =	48.3
TOTAL HEPTA-FURANS	64.6	0.0685	2,3,7,8-TCDD TEQs (ND=1/2 DL) =	48.3

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	62.2
13C-1,2,3,7,8-PECDD	67.8
13C-1,2,3,6,7,8-HXCDD	67.4
13C-1,2,3,4,6,7,8-HPCDD	65.8
13C-OCDD	62.5
13C-2,3,7,8-TCDF	64.1
13C-1,2,3,7,8-PECDF	64.8
13C-1,2,3,4,7,8-HXCDF	65.1
13C-1,2,3,4,6,7,8-HPCDF	65.3

1. SDL = Sample Detection Limit
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4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

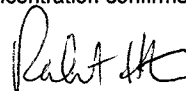
<b>CLIENT SAMPLE I.D.:</b>	05VN-086	<b>AXYS FILE:</b>	L8155-27 L
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	04-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	23-Sep-2005
<b>SAMPLE SIZE:</b>	9.88 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	26.2	<b>ANALYSIS DATE:</b>	28-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	40.6	0.0510		
1,2,3,7,8-PECDD	1.68	0.0510		
1,2,3,4,7,8-HXCDD	4.93	0.100		
1,2,3,6,7,8-HXCDD	6.91	0.101		
1,2,3,7,8,9-HXCDD	14.1	0.100		
1,2,3,4,6,7,8-HPCDD	198	0.147		
OCDD	1650	0.0899		
2,3,7,8-TCDF *	1.94	0.0509		
1,2,3,7,8-PECDF	0.895	0.0560		
2,3,4,7,8-PECDF	1.08	0.0560		
1,2,3,4,7,8-HXCDF	3.06	0.0550		
1,2,3,6,7,8-HXCDF	1.83	0.0550		
2,3,4,6,7,8-HXCDF	1.20	0.0550		
1,2,3,7,8,9-HXCDF	0.328	0.0550		
1,2,3,4,6,7,8-HPCDF	26.3	0.0510		
1,2,3,4,7,8,9-HPCDF	1.90	0.0510		
OCDF	53.4	0.0510		
TOTAL TETRA-DIOXINS	50.7	0.0510		
TOTAL PENTA-DIOXINS	19.0	0.0510		
TOTAL HEXA-DIOXINS	105	0.100		
TOTAL HEPTA-DIOXINS	559	0.147		
TOTAL TETRA-FURANS	20.8	0.123		
TOTAL PENTA-FURANS	29.6	0.0560	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEXA-FURANS	45.3	0.0550	2,3,7,8-TCDD TEQs (ND=0) =	48.7
TOTAL HEPTA-FURANS	69.7	0.0510	2,3,7,8-TCDD TEQs (ND=1/2 DL) =	48.7

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	39.0
13C-1,2,3,7,8-PECDD	48.0
13C-1,2,3,6,7,8-HXCDD	46.0
13C-1,2,3,4,6,7,8-HPCDD	39.5
13C-OCDD	31.4
13C-2,3,7,8-TCDF	37.7
13C-1,2,3,7,8-PECDF	42.3
13C-1,2,3,4,7,8-HXCDF	45.6
13C-1,2,3,4,6,7,8-HPCDF	42.0

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

CLIENT SAMPLE I.D.: 05VN-087  
SAMPLE COLLECTION: N/A  
CLIENT NO.: 2607

SAMPLE TYPE: SOIL  
SAMPLE SIZE: 10.6 g (dry)

% Moisture: 0

AXYS FILE: L7744-37

REPORT DATE: 14-Jun-2005  
METHOD NO.: AXYS METHOD MLA-017 Rev 09  
EXTRACTION DATE: 28-Apr-2005  
INSTRUMENT: HR GC/MS  
ANALYSIS DATE: 15-May-2005  
CONCENTRATION IN: pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)
2,3,7,8-TCDD	257	0.0474
1,2,3,7,8-PECDD	6.76	0.0474
1,2,3,4,7,8-HXCDD	0.886	0.0474
1,2,3,6,7,8-HXCDD	2.72	0.0474
1,2,3,7,8,9-HXCDD	2.05	0.0474
1,2,3,4,6,7,8-HPCDD	29.9	0.0684
OCDD	201	0.0545
2,3,7,8-TCDF *	18.2	0.0470
1,2,3,7,8-PECDF	1.14	0.0474
2,3,4,7,8-PECDF	1.25	0.0474
1,2,3,4,7,8-HXCDF	0.688	0.0474
1,2,3,6,7,8-HXCDF	0.430	0.0474
2,3,4,6,7,8-HXCDF	0.384	0.0474
1,2,3,7,8,9-HXCDF	0.708	0.0474
1,2,3,4,6,7,8-HPCDF	4.30	0.0474
1,2,3,4,7,8,9-HPCDF	NDR (0.325)	0.0474
OCDF	6.40	0.0474
TOTAL TETRA-DIOXINS	290	0.0474
TOTAL PENTA-DIOXINS	32.0	0.0474
TOTAL HEXA-DIOXINS	36.1	0.0474
TOTAL HEPTA-DIOXINS	69.3	0.0684
TOTAL TETRA-FURANS	84.3	0.0474
TOTAL PENTA-FURANS	83.8	0.0474
TOTAL HEXA-FURANS	15.5	0.0474
TOTAL HEPTA-FURANS	9.64	0.0474

**2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)**

2,3,7,8-TCDD TEQs (ND=0) = 267  
2,3,7,8-TCDD TEQs (ND=1/2 DL) = 267

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	80.8
13C-1,2,3,7,8-PECDD	110
13C-1,2,3,6,7,8-HXCDD	90.3
13C-1,2,3,4,6,7,8-HPCDD	81.1
13C-OCDD	73.0
13C-2,3,7,8-TCDF	76.9
13C-1,2,3,7,8-PECDF	82.5
13C-1,2,3,4,7,8-HXCDF	88.6
13C-1,2,3,4,6,7,8-HPCDF	82.1

1. SDL = Sample Detection Limit
2. ND = Not detected
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5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*[Signature]*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-088

**SAMPLE COLLECTION:** N/A

**CLIENT NO.:** 2607

**SAMPLE TYPE:** SEDIMENT

**SAMPLE SIZE:** 10.6 g (dry)

**% Moisture:** 36.9

**AXYS FILE:** L7744-38

**REPORT DATE:** 14-Jun-2005

**METHOD NO.:** AXYS METHOD MLA-017 Rev 09

**EXTRACTION DATE:** 28-Apr-2005

**INSTRUMENT:** HR GC/MS

**ANALYSIS DATE:** 15-May-2005

**CONCENTRATION IN:** pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	82.8	0.0474	
1,2,3,7,8-PECDD	4.56	0.0474	
1,2,3,4,7,8-HXCDD	5.99	0.0951	
1,2,3,6,7,8-HXCDD	18.2	0.0951	
1,2,3,7,8,9-HXCDD	14.8	0.0951	
1,2,3,4,6,7,8-HPCDD	444	0.198	
OCDD	3300	0.185	
2,3,7,8-TCDF *	6.98	0.0470	
1,2,3,7,8-PECDF	2.45	0.0474	
2,3,4,7,8-PECDF	2.80	0.0474	
1,2,3,4,7,8-HXCDF	7.95	0.137	
1,2,3,6,7,8-HXCDF	5.50	0.137	
2,3,4,6,7,8-HXCDF	3.11	0.137	
1,2,3,7,8,9-HXCDF	0.824	0.137	
1,2,3,4,6,7,8-HPCDF	64.2	0.0474	
1,2,3,4,7,8,9-HPCDF	5.17	0.0474	
OCDF	106	0.0316	
TOTAL TETRA-DIOXINS	102	0.0474	
TOTAL PENTA-DIOXINS	36.7	0.0474	
TOTAL HEXA-DIOXINS	145	0.0951	
TOTAL HEPTA-DIOXINS	888	0.198	
TOTAL TETRA-FURANS	50.0	0.0596	
TOTAL PENTA-FURANS	86.5	0.0474	
TOTAL HEXA-FURANS	119	0.137	
TOTAL HEPTA-FURANS	172	0.0474	
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>
			2,3,7,8-TCDD TEQs (ND=0) = 101
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 101

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	88.1
13C-1,2,3,7,8-PECDD	99.1
13C-1,2,3,6,7,8-HXCDD	93.1
13C-1,2,3,4,6,7,8-HPCDD	92.3
13C-OCDD	97.9
13C-2,3,7,8-TCDF	87.1
13C-1,2,3,7,8-PECDF	88.5
13C-1,2,3,4,7,8-HXCDF	91.2
13C-1,2,3,4,6,7,8-HPCDF	87.3

1. SDL = Sample Detection Limit
2. ND = Not detected
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4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist





**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-089  
**SAMPLE COLLECTION:** N/A  
**CLIENT NO.:** 2607  
  
**SAMPLE TYPE:** SOIL  
**SAMPLE SIZE:** 8.92 g (dry)  
  
**% Moisture:** 32.8

**AXYS FILE:** L7744-39  
  
**REPORT DATE:** 14-Jun-2005  
**METHOD NO.:** AXYS METHOD MLA-017 Rev 09  
**EXTRACTION DATE:** 28-Apr-2005  
**INSTRUMENT:** HR GC/MS  
**ANALYSIS DATE:** 15-May-2005  
**CONCENTRATION IN:** pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	392	0.0568		
1,2,3,7,8-PECDD	9.73	0.0561		
1,2,3,4,7,8-HXCDD	8.89	0.332		
1,2,3,6,7,8-HXCDD	28.6	0.332		
1,2,3,7,8,9-HXCDD	24.3	0.332		
1,2,3,4,6,7,8-HPCDD	668	0.456		
OCDD	5350	0.290		
2,3,7,8-TCDF *	15.0	0.0560		
1,2,3,7,8-PECDF	4.60	0.0658		
2,3,4,7,8-PECDF	5.73	0.0658		
1,2,3,4,7,8-HXCDF	14.5	0.576		
1,2,3,6,7,8-HXCDF	8.32	0.576		
2,3,4,6,7,8-HXCDF	5.63	0.576		
1,2,3,7,8,9-HXCDF	1.60	0.576		
1,2,3,4,6,7,8-HPCDF	103	0.122		
1,2,3,4,7,8,9-HPCDF	8.53	0.122		
OCDF	168	0.109		
TOTAL TETRA-DIOXINS	451	0.0568		
TOTAL PENTA-DIOXINS	84.8	0.0561		
TOTAL HEXA-DIOXINS	272	0.332		
TOTAL HEPTA-DIOXINS	1520	0.456		
TOTAL TETRA-FURANS	141	0.0959		
TOTAL PENTA-FURANS	195	0.0658	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEXA-FURANS	194	0.576	2,3,7,8-TCDD TEQs (ND=0) =	424
TOTAL HEPTA-FURANS	292	0.122	2,3,7,8-TCDD TEQs (ND=1/2 DL) =	424

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	40.3
13C-1,2,3,7,8-PECDD	42.7
13C-1,2,3,6,7,8-HXCDD	42.0
13C-1,2,3,4,6,7,8-HPCDD	41.4
13C-OCDD	41.9
13C-2,3,7,8-TCDF	40.3
13C-1,2,3,7,8-PECDF	40.8
13C-1,2,3,4,7,8-HXCDF	42.4
13C-1,2,3,4,6,7,8-HPCDF	38.8

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-094

**SAMPLE COLLECTION:** N/A

**CLIENT NO.:** 2607

**SAMPLE TYPE:** SEDIMENT

**SAMPLE SIZE:** 11.5 g (dry)

**% Moisture:** 36.7

**AXYS FILE:** L7744-40

**REPORT DATE:** 14-Jun-2005

**METHOD NO.:** AXYS METHOD MLA-017 Rev 09

**EXTRACTION DATE:** 28-Apr-2005

**INSTRUMENT:** HR GC/MS

**ANALYSIS DATE:** 15-May-2005

**CONCENTRATION IN:** pg/g (dry weight basis)

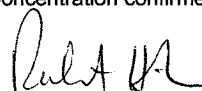
COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	5.22	0.0435		
1,2,3,7,8-PECDD	0.803	0.0435		
1,2,3,4,7,8-HXCDD	0.923	0.101		
1,2,3,6,7,8-HXCDD	2.76	0.101		
1,2,3,7,8,9-HXCDD	4.12	0.101		
1,2,3,4,6,7,8-HPCDD	66.9	0.125		
OCDD	717	0.113		
2,3,7,8-TCDF *	0.644	0.0440		
1,2,3,7,8-PECDF	0.568	0.0435		
2,3,4,7,8-PECDF	0.459	0.0435		
1,2,3,4,7,8-HXCDF	0.748	0.0530		
1,2,3,6,7,8-HXCDF	1.45	0.0530		
2,3,4,6,7,8-HXCDF	0.384	0.0530		
1,2,3,7,8,9-HXCDF	0.415	0.0530		
1,2,3,4,6,7,8-HPCDF	6.65	0.0941		
1,2,3,4,7,8,9-HPCDF	0.579	0.0941		
OCDF	15.7	0.166		
TOTAL TETRA-DIOXINS	14.4	0.0435		
TOTAL PENTA-DIOXINS	9.52	0.0435		
TOTAL HEXA-DIOXINS	38.3	0.101		
TOTAL HEPTA-DIOXINS	146	0.125		
TOTAL TETRA-FURANS	8.99	0.0435		
TOTAL PENTA-FURANS	8.61	0.0435		
TOTAL HEXA-FURANS	14.6	0.0530		
TOTAL HEPTA-FURANS	18.4	0.0941		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	8.24
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	8.24

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	57.1
13C-1,2,3,7,8-PECDD	57.0
13C-1,2,3,6,7,8-HXCDD	57.1
13C-1,2,3,4,6,7,8-HPCDD	54.2
13C-OCDD	49.3
13C-2,3,7,8-TCDF	55.0
13C-1,2,3,7,8-PECDF	53.6
13C-1,2,3,4,7,8-HXCDF	59.9
13C-1,2,3,4,6,7,8-HPCDF	55.6

1. SDL = Sample Detection Limit
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4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-095  
**SAMPLE COLLECTION:** N/A  
**CLIENT NO.:** 2607  
  
**SAMPLE TYPE:** SOIL  
**SAMPLE SIZE:** 10.2 g (dry)  
  
**% Moisture:** 41.9

**AXYS FILE:** L7744-41  
  
**REPORT DATE:** 14-Jun-2005  
**METHOD NO.:** AXYS METHOD MLA-017 Rev 09  
**EXTRACTION DATE:** 28-Apr-2005  
**INSTRUMENT:** HR GC/MS  
**ANALYSIS DATE:** 15-May-2005  
**CONCENTRATION IN:** pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	208	0.0980		
1,2,3,7,8-PECDD	5.66	0.0980		
1,2,3,4,7,8-HXCDD	3.33	0.196		
1,2,3,6,7,8-HXCDD	11.2	0.196		
1,2,3,7,8,9-HXCDD	11.5	0.196		
1,2,3,4,6,7,8-HPCDD	228	0.225		
OCDD	1840	2.60		
2,3,7,8-TCDF *	26.6	0.0490		
1,2,3,7,8-PECDF	2.40	0.0980		
2,3,4,7,8-PECDF	2.01	0.0980		
1,2,3,4,7,8-HXCDF	3.29	0.196		
1,2,3,6,7,8-HXCDF	4.67	0.196		
2,3,4,6,7,8-HXCDF	1.94	0.196		
1,2,3,7,8,9-HXCDF	2.11	0.196		
1,2,3,4,6,7,8-HPCDF	33.1	0.196		
1,2,3,4,7,8,9-HPCDF	2.51	0.196		
OCDF	58.4	0.0943		
TOTAL TETRA-DIOXINS	233	0.0490		
TOTAL PENTA-DIOXINS	43.5	0.0490		
TOTAL HEXA-DIOXINS	107	0.0605		
TOTAL HEPTA-DIOXINS	439	0.225		
TOTAL TETRA-FURANS	94.7	0.133		
TOTAL PENTA-FURANS	90.7	0.0490		
TOTAL HEXA-FURANS	64.6	0.0673	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEPTA-FURANS	83.8	0.0894	2,3,7,8-TCDD TEQs (ND=0) =	224
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	224

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	61.9
13C-1,2,3,7,8-PECDD	66.5
13C-1,2,3,6,7,8-HXCDD	61.8
13C-1,2,3,4,6,7,8-HPCDD	68.1
13C-OCDD	82.1
13C-2,3,7,8-TCDF	60.7
13C-1,2,3,7,8-PECDF	62.1
13C-1,2,3,4,7,8-HXCDF	56.1
13C-1,2,3,4,6,7,8-HPCDF	61.2

1. SDL = Sample Detection Limit
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3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-096	<b>AXYS FILE:</b>	L8155-28 R
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	03-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	21-Oct-2005
<b>SAMPLE SIZE:</b>	10.4 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	20.3	<b>ANALYSIS DATE:</b>	29-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

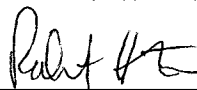
COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	0.596	0.0480		
1,2,3,7,8-PECDD	0.469	0.0480		
1,2,3,4,7,8-HXCDD	0.547	0.0480		
1,2,3,6,7,8-HXCDD	2.15	0.0480		
1,2,3,7,8,9-HXCDD	3.76	0.0480		
1,2,3,4,6,7,8-HPCDD	37.2	0.0708		
OCDD	627	0.0480		
2,3,7,8-TCDF *	0.387	0.0480		
1,2,3,7,8-PECDF	0.880	0.0500		
2,3,4,7,8-PECDF	0.348	0.0501		
1,2,3,4,7,8-HXCDF	0.384	0.0480		
1,2,3,6,7,8-HXCDF	0.450	0.0480		
2,3,4,6,7,8-HXCDF	0.270	0.0480		
1,2,3,7,8,9-HXCDF	2.22	0.0480		
1,2,3,4,6,7,8-HPCDF	2.45	0.0480		
1,2,3,4,7,8,9-HPCDF	0.207	0.0480		
OCDF	4.43	0.0480		
TOTAL TETRA-DIOXINS	8.55	0.0480		
TOTAL PENTA-DIOXINS	6.59	0.0480		
TOTAL HEXA-DIOXINS	23.1	0.0480		
TOTAL HEPTA-DIOXINS	92.1	0.0708		
TOTAL TETRA-FURANS	38.5	0.0809		
TOTAL PENTA-FURANS	5.67	0.0500	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEXA-FURANS	6.60	0.0480	2,3,7,8-TCDD TEQs (ND=0) =	2.76
TOTAL HEPTA-FURANS	5.37	0.0480	2,3,7,8-TCDD TEQs (ND=1/2 DL) =	2.76

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	78.3
13C-1,2,3,7,8-PECDD	90.7
13C-1,2,3,6,7,8-HXCDD	83.9
13C-1,2,3,4,6,7,8-HPCDD	82.0
13C-OCDD	76.1
13C-2,3,7,8-TCDF	74.1
13C-1,2,3,7,8-PECDF	86.0
13C-1,2,3,4,7,8-HXCDF	81.0
13C-1,2,3,4,6,7,8-HPCDF	82.8

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-097

**AXYS FILE:** L7744-42 L

**SAMPLE COLLECTION:** N/A

**CLIENT NO.:** 2607

**REPORT DATE:** 26-May-2005

**METHOD NO.:** AXYS METHOD MLA-017 Rev 09

**SAMPLE TYPE:** SEDIMENT

**EXTRACTION DATE:** 24-Apr-2005

**SAMPLE SIZE:** 10.9 g (dry)

**INSTRUMENT:** HR GC/MS

**ANALYSIS DATE:** 19-May-2005

**% Moisture:** 72.1

**CONCENTRATION IN:** pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	3.73	0.0460	
1,2,3,7,8-PECDD	2.45	0.0460	
1,2,3,4,7,8-HXCDD	3.01	0.170	
1,2,3,6,7,8-HXCDD	8.95	0.170	
1,2,3,7,8,9-HXCDD	9.25	0.170	
1,2,3,4,6,7,8-HPCDD	203	0.140	
OCDD	2470	0.324	
2,3,7,8-TCDF *	2.12	0.0460	
1,2,3,7,8-PECDF	2.15	0.0570	
2,3,4,7,8-PECDF	2.58	0.0570	
1,2,3,4,7,8-HXCDF	6.59	0.0570	
1,2,3,6,7,8-HXCDF	5.21	0.0570	
2,3,4,6,7,8-HXCDF	3.56	0.0570	
1,2,3,7,8,9-HXCDF	0.550	0.0570	
1,2,3,4,6,7,8-HPCDF	92.3	0.110	
1,2,3,4,7,8,9-HPCDF	7.68	0.110	
OCDF	296	0.0529	
TOTAL TETRA-DIOXINS	27.5	0.0460	
TOTAL PENTA-DIOXINS	29.7	0.0460	
TOTAL HEXA-DIOXINS	83.1	0.170	
TOTAL HEPTA-DIOXINS	404	0.140	
TOTAL TETRA-FURANS	46.0	0.180	
TOTAL PENTA-FURANS	42.1	0.0570	
TOTAL HEXA-FURANS	81.1	0.0570	
TOTAL HEPTA-FURANS	217	0.110	
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>
			2,3,7,8-TCDD TEQs (ND=0) = 14.8
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 14.8

**Surrogate Standards** **% Recovery**

13C-2,3,7,8-TCDD	55.7
13C-1,2,3,7,8-PECDD	65.9
13C-1,2,3,6,7,8-HXCDD	54.4
13C-1,2,3,4,6,7,8-HPCDD	54.2
13C-OCDD	38.9
13C-2,3,7,8-TCDF	55.7
13C-1,2,3,7,8-PECDF	64.0
13C-1,2,3,4,7,8-HXCDF	55.4
13C-1,2,3,4,6,7,8-HPCDF	50.8

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-098

**AXYS FILE:** L7744-43

**SAMPLE COLLECTION:** N/A

**CLIENT NO.:** 2607

**REPORT DATE:** 26-May-2005

**METHOD NO.:** AXYS METHOD MLA-017 Rev 09

**SAMPLE TYPE:** SEDIMENT

**EXTRACTION DATE:** 24-Apr-2005

**SAMPLE SIZE:** 11.7 g (dry)

**INSTRUMENT:** HR GC/MS

**ANALYSIS DATE:** 06-May-2005

**% Moisture:** 51.5

**CONCENTRATION IN:** pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	0.969	0.0430		
1,2,3,7,8-PECDD	0.321	0.0430		
1,2,3,4,7,8-HXCDD	0.530	0.0500		
1,2,3,6,7,8-HXCDD	1.80	0.0500		
1,2,3,7,8,9-HXCDD	4.42	0.0500		
1,2,3,4,6,7,8-HPCDD	83.3	0.110		
OCDD	1010	0.0430		
2,3,7,8-TCDF *	0.182	0.0430		
1,2,3,7,8-PECDF	0.194	0.0430		
2,3,4,7,8-PECDF	0.226	0.0430		
1,2,3,4,7,8-HXCDF	0.512	0.0430		
1,2,3,6,7,8-HXCDF	0.449	0.0430		
2,3,4,6,7,8-HXCDF	0.291	0.0430		
1,2,3,7,8,9-HXCDF	0.070	0.0430		
1,2,3,4,6,7,8-HPCDF	8.25	0.0430		
1,2,3,4,7,8,9-HPCDF	0.608	0.0430		
OCDF	24.4	0.0430		
TOTAL TETRA-DIOXINS	14.2	0.0430		
TOTAL PENTA-DIOXINS	17.9	0.0430		
TOTAL HEXA-DIOXINS	88.9	0.0500		
TOTAL HEPTA-DIOXINS	288	0.110		
TOTAL TETRA-FURANS	3.99	0.0430		
TOTAL PENTA-FURANS	3.58	0.0430		
TOTAL HEXA-FURANS	7.32	0.0430	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEPTA-FURANS	20.5	0.0430	2,3,7,8-TCDD TEQs (ND=0) =	3.26
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	3.26

**Surrogate Standards**

**% Recovery**

13C-2,3,7,8-TCDD	71.1
13C-1,2,3,7,8-PECDD	77.6
13C-1,2,3,6,7,8-HXCDD	72.2
13C-1,2,3,4,6,7,8-HPCDD	74.5
13C-OCDD	64.3
13C-2,3,7,8-TCDF	70.5
13C-1,2,3,7,8-PECDF	76.2
13C-1,2,3,4,7,8-HXCDF	76.4
13C-1,2,3,4,6,7,8-HPCDF	71.2

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-101  
**SAMPLE COLLECTION:** N/A  
**CLIENT NO.:** 2607

**SAMPLE TYPE:** SEDIMENT  
**SAMPLE SIZE:** 11.8 g (dry)

**% Moisture:** 47.8

**AXYS FILE:** L7744-44 (A)

**REPORT DATE:** 14-Jun-2005  
**METHOD NO.:** AXYS METHOD MLA-017 Rev 09  
**EXTRACTION DATE:** 28-Apr-2005  
**INSTRUMENT:** HR GC/MS  
**ANALYSIS DATE:** 15-May-2005  
**CONCENTRATION IN:** pg/g (dry weight basis)

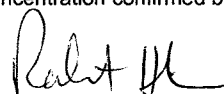
COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	2.72	0.0420		
1,2,3,7,8-PECDD	1.13	0.0420		
1,2,3,4,7,8-HXCDD	2.46	0.167		
1,2,3,6,7,8-HXCDD	5.27	0.167		
1,2,3,7,8,9-HXCDD	6.34	0.167		
1,2,3,4,6,7,8-HPCDD	145	0.435		
OCDD	1770	14.3		
2,3,7,8-TCDF *	1.05	0.0420		
1,2,3,7,8-PECDF	0.895	0.0650		
2,3,4,7,8-PECDF	1.15	0.0650		
1,2,3,4,7,8-HXCDF	3.17	0.0627		
1,2,3,6,7,8-HXCDF	2.31	0.0627		
2,3,4,6,7,8-HXCDF	1.52	0.0627		
1,2,3,7,8,9-HXCDF	0.433	0.0627		
1,2,3,4,6,7,8-HPCDF	60.8	0.270		
1,2,3,4,7,8,9-HPCDF	4.85	0.270		
OCDF	223	1.55		
TOTAL TETRA-DIOXINS	14.1	0.0420		
TOTAL PENTA-DIOXINS	15.5	0.0420		
TOTAL HEXA-DIOXINS	68.5	0.167		
TOTAL HEPTA-DIOXINS	310	0.435		
TOTAL TETRA-FURANS	19.7	0.0760		
TOTAL PENTA-FURANS	21.7	0.0650		
TOTAL HEXA-FURANS	49.9	0.0627		
TOTAL HEPTA-FURANS	179	0.270		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	9.03
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	9.03

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	70.5
13C-1,2,3,7,8-PECDD	73.5
13C-1,2,3,6,7,8-HXCDD	59.1
13C-1,2,3,4,6,7,8-HPCDD	67.9
13C-OCDD	71.5
13C-2,3,7,8-TCDF	70.1
13C-1,2,3,7,8-PECDF	67.7
13C-1,2,3,4,7,8-HXCDF	69.5
13C-1,2,3,4,6,7,8-HPCDF	65.9

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist





**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-101 (Duplicate)	<b>AXYS FILE:</b>	WG15628-103 (DUP L7744-44)
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	14-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	28-Apr-2005
<b>SAMPLE SIZE:</b>	11.6 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	49.0	<b>ANALYSIS DATE:</b>	14-May-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	2.73	0.0430	
1,2,3,7,8-PECDD	1.15	0.0430	
1,2,3,4,7,8-HXCDD	2.07	0.131	
1,2,3,6,7,8-HXCDD	5.07	0.131	
1,2,3,7,8,9-HXCDD	5.74	0.131	
1,2,3,4,6,7,8-HPCDD	137	0.445	
OCDD	1680	11.2	
2,3,7,8-TCDF *	0.934	0.0430	
1,2,3,7,8-PECDF	0.925	0.0430	
2,3,4,7,8-PECDF	1.14	0.0430	
1,2,3,4,7,8-HXCDF	3.01	0.0647	
1,2,3,6,7,8-HXCDF	2.38	0.0647	
2,3,4,6,7,8-HXCDF	1.57	0.0647	
1,2,3,7,8,9-HXCDF	0.495	0.0647	
1,2,3,4,6,7,8-HPCDF	58.0	0.315	
1,2,3,4,7,8,9-HPCDF	4.68	0.315	
OCDF	214	1.23	
TOTAL TETRA-DIOXINS	13.4	0.0430	
TOTAL PENTA-DIOXINS	16.0	0.0430	
TOTAL HEXA-DIOXINS	61.1	0.131	
TOTAL HEPTA-DIOXINS	288	0.445	
TOTAL TETRA-FURANS	17.3	0.0670	
TOTAL PENTA-FURANS	21.4	0.0430	
TOTAL HEXA-FURANS	49.3	0.0647	
TOTAL HEPTA-FURANS	176	0.315	
		<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
		2,3,7,8-TCDD TEQs (ND=0) =	8.81
		2,3,7,8-TCDD TEQs (ND=1/2 DL) =	8.81

Surrogate Standards	% Recovery
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13C-2,3,7,8-TCDD	72.9
13C-1,2,3,7,8-PECDD	73.0
13C-1,2,3,6,7,8-HXCDD	62.3
13C-1,2,3,4,6,7,8-HPCDD	64.1
13C-OCDD	75.0
13C-2,3,7,8-TCDF	69.9
13C-1,2,3,7,8-PECDF	67.4
13C-1,2,3,4,7,8-HXCDF	65.9
13C-1,2,3,4,6,7,8-HPCDF	61.6

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-102  
**SAMPLE COLLECTION:** N/A  
**CLIENT NO.:** 2607

**AXYS FILE:** L7744-45 L

**REPORT DATE:** 26-May-2005  
**METHOD NO.:** AXYS METHOD MLA-017 Rev 09  
**EXTRACTION DATE:** 24-Apr-2005  
**INSTRUMENT:** HR GC/MS  
**ANALYSIS DATE:** 19-May-2005  
**CONCENTRATION IN:** pg/g (dry weight basis)

**SAMPLE TYPE:** SEDIMENT  
**SAMPLE SIZE:** 3.27 g (dry)  
**% Moisture:** 84.3

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	96.0	0.152	
1,2,3,7,8-PECDD	10.7	0.152	
1,2,3,4,7,8-HXCDD	11.4	0.264	
1,2,3,6,7,8-HXCDD	30.0	0.264	
1,2,3,7,8,9-HXCDD	31.7	0.264	
1,2,3,4,6,7,8-HPCDD	577	0.466	
OCDD	4560	0.761	
2,3,7,8-TCDF *	13.7	0.152	
1,2,3,7,8-PECDF	6.60	0.152	
2,3,4,7,8-PECDF	8.70	0.152	
1,2,3,4,7,8-HXCDF	14.2	0.326	
1,2,3,6,7,8-HXCDF	11.3	0.326	
2,3,4,6,7,8-HXCDF	8.89	0.326	
1,2,3,7,8,9-HXCDF	1.55	0.326	
1,2,3,4,6,7,8-HPCDF	102	0.186	
1,2,3,4,7,8,9-HPCDF	8.35	0.186	
OCDF	200	0.152	
TOTAL TETRA-DIOXINS	176	0.152	
TOTAL PENTA-DIOXINS	98.4	0.152	
TOTAL HEXA-DIOXINS	268	0.264	
TOTAL HEPTA-DIOXINS	1110	0.466	
TOTAL TETRA-FURANS	165	0.528	
TOTAL PENTA-FURANS	148	0.152	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)
TOTAL HEXA-FURANS	173	0.326	2,3,7,8-TCDD TEQs (ND=0) = 131
TOTAL HEPTA-FURANS	260	0.186	2,3,7,8-TCDD TEQs (ND=1/2 DL) = 131

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	51.6
13C-1,2,3,7,8-PECDD	61.4
13C-1,2,3,6,7,8-HXCDD	49.9
13C-1,2,3,4,6,7,8-HPCDD	51.1
13C-OCDD	33.8
13C-2,3,7,8-TCDF	49.3
13C-1,2,3,7,8-PECDF	54.9
13C-1,2,3,4,7,8-HXCDF	49.9
13C-1,2,3,4,6,7,8-HPCDF	45.8

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-103	<b>AXYS FILE:</b>	L8155-29
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	04-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	23-Sep-2005
<b>SAMPLE SIZE:</b>	10.3 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	39.0	<b>ANALYSIS DATE:</b>	09-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	31.1	0.0480		
1,2,3,7,8-PECDD	1.03	0.0480		
1,2,3,4,7,8-HXCDD	0.667	0.139		
1,2,3,6,7,8-HXCDD	4.06	0.139		
1,2,3,7,8,9-HXCDD	10.1	0.139		
1,2,3,4,6,7,8-HPCDD	88.1	0.197		
OCDD	806	0.121		
2,3,7,8-TCDF *	5.22	0.0480		
1,2,3,7,8-PECDF	2.16	0.0510		
2,3,4,7,8-PECDF	0.332	0.0510		
1,2,3,4,7,8-HXCDF	0.378	0.0480		
1,2,3,6,7,8-HXCDF	0.952	0.0480		
2,3,4,6,7,8-HXCDF	0.206	0.0480		
1,2,3,7,8,9-HXCDF	4.13	0.0480		
1,2,3,4,6,7,8-HPCDF	3.18	0.0576		
1,2,3,4,7,8,9-HPCDF	0.371	0.0576		
OCDF	6.06	0.0480		
TOTAL TETRA-DIOXINS	149	0.0480		
TOTAL PENTA-DIOXINS	22.2	0.0480		
TOTAL HEXA-DIOXINS	61.1	0.139		
TOTAL HEPTA-DIOXINS	154	0.197		
TOTAL TETRA-FURANS	86.8	0.118		
TOTAL PENTA-FURANS	17.5	0.0510	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEXA-FURANS	11.4	0.0480	2,3,7,8-TCDD TEQs (ND=0) =	36.0
TOTAL HEPTA-FURANS	8.51	0.0576	2,3,7,8-TCDD TEQs (ND=1/2 DL) =	36.0

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	43.3
13C-1,2,3,7,8-PECDD	49.7
13C-1,2,3,6,7,8-HXCDD	50.0
13C-1,2,3,4,6,7,8-HPCDD	54.5
13C-OCDD	51.1
13C-2,3,7,8-TCDF	42.2
13C-1,2,3,7,8-PECDF	45.7
13C-1,2,3,4,7,8-HXCDF	48.8
13C-1,2,3,4,6,7,8-HPCDF	50.2

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



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## **Appendix A4.6**

### **Dioxin Data: Can Tho**

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**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-104	<b>AXYS FILE:</b>	L8155-30 W
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	04-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	23-Sep-2005
<b>SAMPLE SIZE:</b>	10.3 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	58.9	<b>ANALYSIS DATE:</b>	28-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

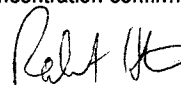
COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	38.5	0.0490	
1,2,3,7,8-PECDD	0.538	0.0584	
1,2,3,4,7,8-HXCDD	0.368	0.0870	
1,2,3,6,7,8-HXCDD	1.22	0.0870	
1,2,3,7,8,9-HXCDD	1.75	0.0870	
1,2,3,4,6,7,8-HPCDD	32.0	0.171	
OCDD	407	0.127	
2,3,7,8-TCDF *	0.856	0.0480	
1,2,3,7,8-PECDF	0.224	0.0990	
2,3,4,7,8-PECDF	0.278	0.0990	
1,2,3,4,7,8-HXCDF	0.363	0.0480	
1,2,3,6,7,8-HXCDF	0.449	0.0480	
2,3,4,6,7,8-HXCDF	0.201	0.0480	
1,2,3,7,8,9-HXCDF	NDR (0.220)	0.0480	
1,2,3,4,6,7,8-HPCDF	2.45	0.0510	
1,2,3,4,7,8,9-HPCDF	0.301	0.0510	
OCDF	5.45	0.0839	
TOTAL TETRA-DIOXINS	44.7	0.0490	
TOTAL PENTA-DIOXINS	7.10	0.0584	
TOTAL HEXA-DIOXINS	25.3	0.0870	
TOTAL HEPTA-DIOXINS	87.0	0.171	
TOTAL TETRA-FURANS	6.18	0.0700	
TOTAL PENTA-FURANS	5.67	0.0990	
TOTAL HEXA-FURANS	7.37	0.0480	
TOTAL HEPTA-FURANS	7.08	0.0510	
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>
			2,3,7,8-TCDD TEQs (ND=0) = 40.1
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 40.1

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	50.4
13C-1,2,3,7,8-PECDD	55.4
13C-1,2,3,6,7,8-HXCDD	53.7
13C-1,2,3,4,6,7,8-HPCDD	52.6
13C-OCDD	45.7
13C-2,3,7,8-TCDF	51.8
13C-1,2,3,7,8-PECDF	53.5
13C-1,2,3,4,7,8-HXCDF	54.2
13C-1,2,3,4,6,7,8-HPCDF	50.8

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-105	<b>AXYS FILE:</b>	L8155-31
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	01-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	28-Sep-2005
<b>SAMPLE SIZE:</b>	10.8 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	7.22	<b>ANALYSIS DATE:</b>	15-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	0.388	0.0470	
1,2,3,7,8-PECDD	0.242	0.0470	
1,2,3,4,7,8-HXCDD	0.387	0.0470	
1,2,3,6,7,8-HXCDD	2.06	0.0470	
1,2,3,7,8,9-HXCDD	1.29	0.0470	
1,2,3,4,6,7,8-HPCDD	47.1	0.0683	
OCDD	522	0.0951	
2,3,7,8-TCDF *	0.157	0.0470	
1,2,3,7,8-PECDF	0.285	0.0470	
2,3,4,7,8-PECDF	0.470	0.0470	
1,2,3,4,7,8-HXCDF	1.09	0.0470	
1,2,3,6,7,8-HXCDF	0.406	0.0470	
2,3,4,6,7,8-HXCDF	0.323	0.0470	
1,2,3,7,8,9-HXCDF	0.184	0.0470	
1,2,3,4,6,7,8-HPCDF	4.31	0.0470	
1,2,3,4,7,8,9-HPCDF	0.231	0.0470	
OCDF	4.12	0.0470	
TOTAL TETRA-DIOXINS	1.80	0.0470	
TOTAL PENTA-DIOXINS	2.36	0.0470	
TOTAL HEXA-DIOXINS	14.0	0.0470	
TOTAL HEPTA-DIOXINS	91.3	0.186	
TOTAL TETRA-FURANS	3.78	0.0470	
TOTAL PENTA-FURANS	4.74	0.0470	
TOTAL HEXA-FURANS	10.9	0.0470	
TOTAL HEPTA-FURANS	10.2	0.0470	
		<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
		2,3,7,8-TCDD TEQs (ND=0) =	2.04
		2,3,7,8-TCDD TEQs (ND=1/2 DL) =	2.04

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	84.7
13C-1,2,3,7,8-PECDD	93.6
13C-1,2,3,6,7,8-HXCDD	92.0
13C-1,2,3,4,6,7,8-HPCDD	89.7
13C-OCDD	86.6
13C-2,3,7,8-TCDF	82.5
13C-1,2,3,7,8-PECDF	89.3
13C-1,2,3,4,7,8-HXCDF	95.1
13C-1,2,3,4,6,7,8-HPCDF	89.0

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4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*[Signature]*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-108	<b>AXYS FILE:</b>	L8155-32
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	01-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	28-Sep-2005
<b>SAMPLE SIZE:</b>	10.3 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	46.5	<b>ANALYSIS DATE:</b>	15-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	19.2	0.0480	
1,2,3,7,8-PECDD	0.223	0.0480	
1,2,3,4,7,8-HXCDD	0.265	0.0480	
1,2,3,6,7,8-HXCDD	1.11	0.0480	
1,2,3,7,8,9-HXCDD	1.88	0.0480	
1,2,3,4,6,7,8-HPCDD	37.1	0.0685	
OCDD	428	0.0838	
2,3,7,8-TCDF *	0.752	0.0480	
1,2,3,7,8-PECDF	0.244	0.0480	
2,3,4,7,8-PECDF	0.154	0.0480	
1,2,3,4,7,8-HXCDF	0.259	0.0480	
1,2,3,6,7,8-HXCDF	0.277	0.0480	
2,3,4,6,7,8-HXCDF	0.133	0.0480	
1,2,3,7,8,9-HXCDF	0.233	0.0480	
1,2,3,4,6,7,8-HPCDF	4.18	0.0480	
1,2,3,4,7,8,9-HPCDF	0.391	0.0480	
OCDF	16.1	0.0480	
TOTAL TETRA-DIOXINS	27.3	0.0480	
TOTAL PENTA-DIOXINS	6.93	0.0480	
TOTAL HEXA-DIOXINS	25.6	0.0480	
TOTAL HEPTA-DIOXINS	78.2	0.0685	
TOTAL TETRA-FURANS	8.11	0.0572	
TOTAL PENTA-FURANS	4.96	0.0480	
TOTAL HEXA-FURANS	5.85	0.0480	
TOTAL HEPTA-FURANS	13.7	0.0480	
		<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
		2,3,7,8-TCDD TEQs (ND=0) =	20.5
		2,3,7,8-TCDD TEQs (ND=1/2 DL) =	20.5

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	49.5
13C-1,2,3,7,8-PECDD	52.9
13C-1,2,3,6,7,8-HXCDD	53.7
13C-1,2,3,4,6,7,8-HPCDD	52.1
13C-OCDD	50.2
13C-2,3,7,8-TCDF	47.8
13C-1,2,3,7,8-PECDF	51.4
13C-1,2,3,4,7,8-HXCDF	55.6
13C-1,2,3,4,6,7,8-HPCDF	50.8

1. SDL = Sample Detection Limit
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4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*[Signature]*

QA/QC Chemist





**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-110  
**SAMPLE COLLECTION:** N/A  
**CLIENT NO.:** 2607  
  
**SAMPLE TYPE:** SOIL  
**SAMPLE SIZE:** 10.4 g (dry)  
  
**% Moisture:** 43.7

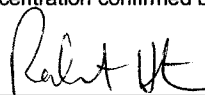
**AXYS FILE:** L7744-46  
  
**REPORT DATE:** 14-Jun-2005  
**METHOD NO.:** AXYS METHOD MLA-017 Rev 09  
**EXTRACTION DATE:** 28-Apr-2005  
**INSTRUMENT:** HR GC/MS  
**ANALYSIS DATE:** 16-May-2005  
**CONCENTRATION IN:** pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	5.24	0.0480	
1,2,3,7,8-PECDD	0.316	0.0480	
1,2,3,4,7,8-HXCDD	0.213	0.0731	
1,2,3,6,7,8-HXCDD	0.824	0.0731	
1,2,3,7,8,9-HXCDD	2.01	0.0731	
1,2,3,4,6,7,8-HPCDD	20.3	0.0853	
OCDD	328	0.125	
2,3,7,8-TCDF *	0.751	0.0480	
1,2,3,7,8-PECDF	0.789	0.0794	
2,3,4,7,8-PECDF	0.217	0.0794	
1,2,3,4,7,8-HXCDF	0.279	0.0480	
1,2,3,6,7,8-HXCDF	0.193	0.0480	
2,3,4,6,7,8-HXCDF	0.124	0.0480	
1,2,3,7,8,9-HXCDF	3.09	0.0480	
1,2,3,4,6,7,8-HPCDF	0.859	0.0480	
1,2,3,4,7,8,9-HPCDF	0.113	0.0480	
OCDF	1.12	0.0480	
TOTAL TETRA-DIOXINS	11.2	0.0480	
TOTAL PENTA-DIOXINS	6.56	0.0480	
TOTAL HEXA-DIOXINS	19.8	0.0731	
TOTAL HEPTA-DIOXINS	59.5	0.0853	
TOTAL TETRA-FURANS	15.8	0.0480	
TOTAL PENTA-FURANS	3.80	0.0794	
TOTAL HEXA-FURANS	5.07	0.0480	
TOTAL HEPTA-FURANS	1.90	0.0480	
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>
			2,3,7,8-TCDD TEQs (ND=0) = 6.70
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 6.70

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	58.4
13C-1,2,3,7,8-PECDD	64.6
13C-1,2,3,6,7,8-HXCDD	62.2
13C-1,2,3,4,6,7,8-HPCDD	66.5
13C-OCDD	73.3
13C-2,3,7,8-TCDF	57.2
13C-1,2,3,7,8-PECDF	62.1
13C-1,2,3,4,7,8-HXCDF	56.3
13C-1,2,3,4,6,7,8-HPCDF	62.6

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-111	<b>AXYS FILE:</b>	L8155-33 LW (A)
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	01-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	28-Sep-2005
<b>SAMPLE SIZE:</b>	10.6 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	17.0	<b>ANALYSIS DATE:</b>	28-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	15.2	0.112	
1,2,3,7,8-PECDD	20.7	0.237	
1,2,3,4,7,8-HXCDD	29.6	0.690	
1,2,3,6,7,8-HXCDD	82.4	0.690	
1,2,3,7,8,9-HXCDD	82.0	0.690	
1,2,3,4,6,7,8-HPCDD	2200	1.03	
OCDD	20100	0.472	
2,3,7,8-TCDF *	5.75	0.0470	
1,2,3,7,8-PECDF	3.97	0.440	
2,3,4,7,8-PECDF	6.35	0.444	
1,2,3,4,7,8-HXCDF	15.4	0.320	
1,2,3,6,7,8-HXCDF	11.9	0.320	
2,3,4,6,7,8-HXCDF	9.84	0.320	
1,2,3,7,8,9-HXCDF	0.723	0.321	
1,2,3,4,6,7,8-HPCDF	220	0.390	
1,2,3,4,7,8,9-HPCDF	11.4	0.394	
OCDF	416	0.472	
TOTAL TETRA-DIOXINS	57.4	0.112	
TOTAL PENTA-DIOXINS	148	0.237	
TOTAL HEXA-DIOXINS	793	0.690	
TOTAL HEPTA-DIOXINS	5000	1.03	
TOTAL TETRA-FURANS	50.5	0.236	
TOTAL PENTA-FURANS	113	0.440	
TOTAL HEXA-FURANS	337	0.320	
TOTAL HEPTA-FURANS	568	0.390	
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>
			2,3,7,8-TCDD TEQs (ND=0) = 89.4
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 89.4

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	78.8
13C-1,2,3,7,8-PECDD	103
13C-1,2,3,6,7,8-HXCDD	85.9
13C-1,2,3,4,6,7,8-HPCDD	83.8
13C-OCDD	81.2
13C-2,3,7,8-TCDF	77.4
13C-1,2,3,7,8-PECDF	92.0
13C-1,2,3,4,7,8-HXCDF	85.7
13C-1,2,3,4,6,7,8-HPCDF	86.0

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*P. Steyn*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-111 (Duplicate)	<b>AXYS FILE:</b>	WG16989-103 LW (DUP L8155-33)
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	07-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	28-Sep-2005
<b>SAMPLE SIZE:</b>	10.3 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	18.5	<b>ANALYSIS DATE:</b>	28-Oct-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	14.2	0.148	
1,2,3,7,8-PECDD	23.8	0.230	
1,2,3,4,7,8-HXCDD	34.2	0.910	
1,2,3,6,7,8-HXCDD	93.7	0.910	
1,2,3,7,8,9-HXCDD	97.4	0.910	
1,2,3,4,6,7,8-HPCDD	2640	1.25	
OCDD	22400	0.486	
2,3,7,8-TCDF *	6.25	0.0490	
1,2,3,7,8-PECDF	4.20	0.420	
2,3,4,7,8-PECDF	6.62	0.420	
1,2,3,4,7,8-HXCDF	16.7	0.320	
1,2,3,6,7,8-HXCDF	13.2	0.320	
2,3,4,6,7,8-HXCDF	11.2	0.320	
1,2,3,7,8,9-HXCDF	0.727	0.323	
1,2,3,4,6,7,8-HPCDF	248	0.520	
1,2,3,4,7,8,9-HPCDF	12.9	0.521	
OCDF	483	0.486	
TOTAL TETRA-DIOXINS	61.5	0.148	
TOTAL PENTA-DIOXINS	177	0.230	
TOTAL HEXA-DIOXINS	930	0.910	
TOTAL HEPTA-DIOXINS	5740	1.25	
TOTAL TETRA-FURANS	54.8	0.193	
TOTAL PENTA-FURANS	123	0.420	
TOTAL HEXA-FURANS	362	0.320	
TOTAL HEPTA-FURANS	663	0.520	
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>
			2,3,7,8-TCDD TEQs (ND=0) = 100
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 100

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	83.9
13C-1,2,3,7,8-PECDD	94.2
13C-1,2,3,6,7,8-HXCDD	87.7
13C-1,2,3,4,6,7,8-HPCDD	85.2
13C-OCDD	88.3
13C-2,3,7,8-TCDF	83.7
13C-1,2,3,7,8-PECDF	90.0
13C-1,2,3,4,7,8-HXCDF	91.7
13C-1,2,3,4,6,7,8-HPCDF	85.6

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*[Signature]*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-112	<b>AXYS FILE:</b>	L7744-47
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	14-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	28-Apr-2005
<b>SAMPLE SIZE:</b>	10.5 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	0.57	<b>ANALYSIS DATE:</b>	16-May-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	49.7	0.0480	
1,2,3,7,8-PECDD	12.6	0.0480	
1,2,3,4,7,8-HXCDD	22.7	0.117	
1,2,3,6,7,8-HXCDD	86.0	0.117	
1,2,3,7,8,9-HXCDD	66.2	0.117	
1,2,3,4,6,7,8-HPCDD	2490	0.736	
OCDD	23100	0.842	
2,3,7,8-TCDF *	1.67	0.0480	
1,2,3,7,8-PECDF	3.68	0.0480	
2,3,4,7,8-PECDF	3.16	0.0480	
1,2,3,4,7,8-HXCDF	20.9	0.0782	
1,2,3,6,7,8-HXCDF	15.1	0.0782	
2,3,4,6,7,8-HXCDF	14.3	0.0782	
1,2,3,7,8,9-HXCDF	1.44	0.0782	
1,2,3,4,6,7,8-HPCDF	359	0.164	
1,2,3,4,7,8,9-HPCDF	20.6	0.164	
OCDF	620	0.101	
TOTAL TETRA-DIOXINS	65.4	0.0480	
TOTAL PENTA-DIOXINS	78.1	0.0480	
TOTAL HEXA-DIOXINS	579	0.117	
TOTAL HEPTA-DIOXINS	4450	0.736	
TOTAL TETRA-FURANS	28.1	0.0480	
TOTAL PENTA-FURANS	120	0.0480	
TOTAL HEXA-FURANS	538	0.0782	
TOTAL HEPTA-FURANS	993	0.164	
		<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
		2,3,7,8-TCDD TEQs (ND=0) =	118
		2,3,7,8-TCDD TEQs (ND=1/2 DL) =	118

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	88.6
13C-1,2,3,7,8-PECDD	95.9
13C-1,2,3,6,7,8-HXCDD	95.0
13C-1,2,3,4,6,7,8-HPCDD	120
13C-OCDD	94.2
13C-2,3,7,8-TCDF	89.4
13C-1,2,3,7,8-PECDF	89.3
13C-1,2,3,4,7,8-HXCDF	85.8
13C-1,2,3,4,6,7,8-HPCDF	94.3

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*Robert H. H.*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-113	<b>AXYS FILE:</b>	L7744-48 i
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	14-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	28-Apr-2005
<b>SAMPLE SIZE:</b>	11.1 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
		<b>ANALYSIS DATE:</b>	18-May-2005
<b>% Moisture:</b>	66.2	<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	6.13	0.0450	
1,2,3,7,8-PECDD	0.703	0.0450	
1,2,3,4,7,8-HXCDD	0.946	0.0572	
1,2,3,6,7,8-HXCDD	3.54	0.0572	
1,2,3,7,8,9-HXCDD	4.18	0.0572	
1,2,3,4,6,7,8-HPCDD	94.9	0.0872	
OCDD	924	1.22	
2,3,7,8-TCDF *	0.602	0.0450	
1,2,3,7,8-PECDF	0.467	0.0450	
2,3,4,7,8-PECDF	0.381	0.0450	
1,2,3,4,7,8-HXCDF	0.886	0.0450	
1,2,3,6,7,8-HXCDF	1.21	0.0450	
2,3,4,6,7,8-HXCDF	0.474	0.0450	
1,2,3,7,8,9-HXCDF	0.244	0.0450	
1,2,3,4,6,7,8-HPCDF	9.83	0.0450	
1,2,3,4,7,8,9-HPCDF	0.757	0.0450	
OCDF	20.5	0.0698	
TOTAL TETRA-DIOXINS	9.50	0.0450	
TOTAL PENTA-DIOXINS	9.72	0.0450	
TOTAL HEXA-DIOXINS	47.6	0.0572	
TOTAL HEPTA-DIOXINS	207	0.0872	
TOTAL TETRA-FURANS	5.84	0.0450	
TOTAL PENTA-FURANS	9.15	0.0450	
TOTAL HEXA-FURANS	16.5	0.0450	
TOTAL HEPTA-FURANS	25.8	0.0450	
		<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
		2,3,7,8-TCDD TEQs (ND=0) =	9.40
		2,3,7,8-TCDD TEQs (ND=1/2 DL) =	9.40

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	67.2
13C-1,2,3,7,8-PECDD	70.9
13C-1,2,3,6,7,8-HXCDD	62.0
13C-1,2,3,4,6,7,8-HPCDD	61.4
13C-OCDD	57.9
13C-2,3,7,8-TCDF	65.7
13C-1,2,3,7,8-PECDF	66.9
13C-1,2,3,4,7,8-HXCDF	63.2
13C-1,2,3,4,6,7,8-HPCDF	60.1

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-116	<b>AXYS FILE:</b>	L7744-49 R
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	28-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	10-Jun-2005
<b>SAMPLE SIZE:</b>	11.2 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	50.1	<b>ANALYSIS DATE:</b>	21-Jun-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	16.1	0.0450		
1,2,3,7,8-PECDD	0.500	0.0450		
1,2,3,4,7,8-HXCDD	0.912	0.0960		
1,2,3,6,7,8-HXCDD	2.23	0.0960		
1,2,3,7,8,9-HXCDD	2.42	0.0960		
1,2,3,4,6,7,8-HPCDD	61.3	0.146		
OCDD	675	11.2		
2,3,7,8-TCDF *	0.896	0.0450		
1,2,3,7,8-PECDF	0.335	0.0450		
2,3,4,7,8-PECDF	0.286	0.0450		
1,2,3,4,7,8-HXCDF	0.807	0.0450		
1,2,3,6,7,8-HXCDF	0.716	0.0450		
2,3,4,6,7,8-HXCDF	0.363	0.0450		
1,2,3,7,8,9-HXCDF	0.195	0.0450		
1,2,3,4,6,7,8-HPCDF	6.47	0.0610		
1,2,3,4,7,8,9-HPCDF	0.499	0.0610		
OCDF	11.3	0.447		
TOTAL TETRA-DIOXINS	19.4	0.0450		
TOTAL PENTA-DIOXINS	6.76	0.0450		
TOTAL HEXA-DIOXINS	28.8	0.0960		
TOTAL HEPTA-DIOXINS	134	0.146		
TOTAL TETRA-FURANS	6.03	0.0533		
TOTAL PENTA-FURANS	9.95	0.0450		
TOTAL HEXA-FURANS	14.3	0.0450		
TOTAL HEPTA-FURANS	17.7	0.0610		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	18.4
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	18.4

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	68.8
13C-1,2,3,7,8-PECDD	66.7
13C-1,2,3,6,7,8-HXCDD	63.0
13C-1,2,3,4,6,7,8-HPCDD	62.2
13C-OCDD	57.0
13C-2,3,7,8-TCDF	65.4
13C-1,2,3,7,8-PECDF	64.1
13C-1,2,3,4,7,8-HXCDF	66.8
13C-1,2,3,4,6,7,8-HPCDF	60.2

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*[Signature]*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-116	<b>AXYS FILE:</b>	L7744-49 R
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	28-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	10-Jun-2005
<b>SAMPLE SIZE:</b>	11.2 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	50.1	<b>ANALYSIS DATE:</b>	17-Jun-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
2,3,7,8-TCDF *	0.896	0.0450	2,3,7,8-TCDD TEQs (ND=0) =	0
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	0

**Surrogate Standards**

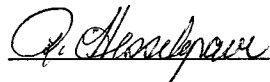
**% Recovery**

13C-2,3,7,8-TCDF

54.7

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist

For Axys Internal Use Only [ XSL Template: AXYS.xsl; Created: 28-Jun-2005 12:48:17; Application: XMLTransformer-1.4.2;  
Report Filename: AXYS\_DIOXINS\_AXYSDB225\_L7744-49\_SJ431883.html; Workgroup: WG15681; Design ID: 194 ]





**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b> 05VN-123	<b>AXYS FILE:</b> L8155-34 i
<b>SAMPLE COLLECTION:</b> N/A	
<b>CLIENT NO.:</b> 2607	<b>REPORT DATE:</b> 07-Nov-2005
	<b>METHOD NO.:</b> AXYS METHOD MLA-017 Rev 10
<b>SAMPLE TYPE:</b> SOIL	<b>EXTRACTION DATE:</b> 28-Sep-2005
<b>SAMPLE SIZE:</b> 10.6 g (dry)	<b>INSTRUMENT:</b> HR GC/MS
	<b>ANALYSIS DATE:</b> 02-Nov-2005
<b>% Moisture:</b> 49.3	<b>CONCENTRATION IN:</b> pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	68.7	0.0470	
1,2,3,7,8-PECDD	0.285	0.0470	
1,2,3,4,7,8-HXCDD	0.338	0.0470	
1,2,3,6,7,8-HXCDD	0.906	0.0470	
1,2,3,7,8,9-HXCDD	1.59	0.0470	
1,2,3,4,6,7,8-HPCDD	22.7	0.0470	
OCDD	304	0.0923	
2,3,7,8-TCDF *	6.23	0.0470	
1,2,3,7,8-PECDF	0.403	0.0470	
2,3,4,7,8-PECDF	0.254	0.0470	
1,2,3,4,7,8-HXCDF	0.301	0.0470	
1,2,3,6,7,8-HXCDF	0.355	0.0470	
2,3,4,6,7,8-HXCDF	0.122	0.0470	
1,2,3,7,8,9-HXCDF	0.182	0.0470	
1,2,3,4,6,7,8-HPCDF	1.22	0.0470	
1,2,3,4,7,8,9-HPCDF	0.142	0.0470	
OCDF	1.56	0.0470	
TOTAL TETRA-DIOXINS	79.0	0.0470	
TOTAL PENTA-DIOXINS	8.80	0.0470	
TOTAL HEXA-DIOXINS	26.0	0.0470	
TOTAL HEPTA-DIOXINS	61.4	0.0470	
TOTAL TETRA-FURANS	17.0	0.0470	
TOTAL PENTA-FURANS	4.86	0.0470	
TOTAL HEXA-FURANS	2.94	0.0470	
TOTAL HEPTA-FURANS	2.60	0.0470	
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>
			2,3,7,8-TCDD TEQs (ND=0) = 70.4
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 70.4

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	70.1
13C-1,2,3,7,8-PECDD	75.2
13C-1,2,3,6,7,8-HXCDD	73.0
13C-1,2,3,4,6,7,8-HPCDD	71.8
13C-OCDD	67.9
13C-2,3,7,8-TCDF	69.3
13C-1,2,3,7,8-PECDF	71.2
13C-1,2,3,4,7,8-HXCDF	70.0
13C-1,2,3,4,6,7,8-HPCDF	69.2

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*[Signature]*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-124

**AXYS FILE:** L7744-50

**SAMPLE COLLECTION:** N/A

**CLIENT NO.:** 2607

**REPORT DATE:** 07-Jun-2005

**METHOD NO.:** AXYS METHOD MLA-017 Rev 09

**SAMPLE TYPE:** SOIL

**EXTRACTION DATE:** 26-Apr-2005

**SAMPLE SIZE:** 10.3 g (dry)

**INSTRUMENT:** HR GC/MS

**ANALYSIS DATE:** 03-May-2005

**% Moisture:** 38.0

**CONCENTRATION IN:** pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	10.4	0.0480	
1,2,3,7,8-PECDD	0.422	0.0480	
1,2,3,4,7,8-HXCDD	0.454	0.0480	
1,2,3,6,7,8-HXCDD	1.25	0.0480	
1,2,3,7,8,9-HXCDD	2.17	0.0480	
1,2,3,4,6,7,8-HPCDD	31.6	0.0810	
OCDD	374	0.0480	
2,3,7,8-TCDF *	1.22	0.0480	
1,2,3,7,8-PECDF	0.508	0.0480	
2,3,4,7,8-PECDF	0.298	0.0480	
1,2,3,4,7,8-HXCDF	0.470	0.0480	
1,2,3,6,7,8-HXCDF	0.357	0.0480	
2,3,4,6,7,8-HXCDF	0.215	0.0480	
1,2,3,7,8,9-HXCDF	0.926	0.0480	
1,2,3,4,6,7,8-HPCDF	2.26	0.0480	
1,2,3,4,7,8,9-HPCDF	0.209	0.0480	
OCDF	2.57	0.0480	
TOTAL TETRA-DIOXINS	17.0	0.0480	
TOTAL PENTA-DIOXINS	7.99	0.0480	
TOTAL HEXA-DIOXINS	26.8	0.0480	
TOTAL HEPTA-DIOXINS	83.4	0.0810	
TOTAL TETRA-FURANS	19.3	0.0480	
TOTAL PENTA-FURANS	4.99	0.0480	
TOTAL HEXA-FURANS	5.49	0.0480	
TOTAL HEPTA-FURANS	5.10	0.0480	
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>
			2,3,7,8-TCDD TEQs (ND=0) = 12.1
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 12.1

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	80.6
13C-1,2,3,7,8-PECDD	87.5
13C-1,2,3,6,7,8-HXCDD	79.7
13C-1,2,3,4,6,7,8-HPCDD	79.4
13C-OCDD	81.1
13C-2,3,7,8-TCDF	79.5
13C-1,2,3,7,8-PECDF	80.7
13C-1,2,3,4,7,8-HXCDF	71.8
13C-1,2,3,4,6,7,8-HPCDF	73.2

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-125  
**SAMPLE COLLECTION:** N/A  
**CLIENT NO.:** 2607

**SAMPLE TYPE:** SEDIMENT  
**SAMPLE SIZE:** 11.8 g (dry)

**% Moisture:** 39.6

**AXYS FILE:** L7744-51

**REPORT DATE:** 07-Jun-2005  
**METHOD NO.:** AXYS METHOD MLA-017 Rev 09  
**EXTRACTION DATE:** 26-Apr-2005  
**INSTRUMENT:** HR GC/MS  
**ANALYSIS DATE:** 03-May-2005  
**CONCENTRATION IN:** pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	4.74	0.0420	
1,2,3,7,8-PECDD	0.411	0.0420	
1,2,3,4,7,8-HxCDD	0.623	0.0570	
1,2,3,6,7,8-HxCDD	2.30	0.0570	
1,2,3,7,8,9-HxCDD	2.20	0.0570	
1,2,3,4,6,7,8-HPCDD	62.9	0.0990	
OCDD	798	0.535	
2,3,7,8-TCDF *	0.270	0.0420	
1,2,3,7,8-PECDF	0.407	0.0420	
2,3,4,7,8-PECDF	0.287	0.0420	
1,2,3,4,7,8-HxCDF	0.684	0.0420	
1,2,3,6,7,8-HxCDF	1.31	0.0420	
2,3,4,6,7,8-HxCDF	0.326	0.0420	
1,2,3,7,8,9-HxCDF	0.233	0.0420	
1,2,3,4,6,7,8-HPCDF	7.40	0.0420	
1,2,3,4,7,8,9-HPCDF	0.794	0.0420	
OCDF	15.9	0.0420	
TOTAL TETRA-DIOXINS	6.89	0.0420	
TOTAL PENTA-DIOXINS	4.73	0.0420	
TOTAL HEXA-DIOXINS	23.5	0.0570	
TOTAL HEPTA-DIOXINS	130	0.0990	
TOTAL TETRA-FURANS	3.21	0.0420	
TOTAL PENTA-FURANS	5.41	0.0420	
TOTAL HEXA-FURANS	14.6	0.0420	
TOTAL HEPTA-FURANS	24.4	0.0420	
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>
			2,3,7,8-TCDD TEQs (ND=0) = 6.90
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 6.90

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	75.7
13C-1,2,3,7,8-PECDD	80.8
13C-1,2,3,6,7,8-HxCDD	68.6
13C-1,2,3,4,6,7,8-HPCDD	76.7
13C-OCDD	78.1
13C-2,3,7,8-TCDF	73.4
13C-1,2,3,7,8-PECDF	75.0
13C-1,2,3,4,7,8-HxCDF	68.7
13C-1,2,3,4,6,7,8-HPCDF	70.2

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



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## **Appendix A4.7**

### **Dioxin Data: Tan Son Nhut**

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**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-126	<b>AXYS FILE:</b>	L7744-52
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	07-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	26-Apr-2005
<b>SAMPLE SIZE:</b>	11.3 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
		<b>ANALYSIS DATE:</b>	03-May-2005
<b>% Moisture:</b>	26.5	<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	0.420	0.0440		
1,2,3,7,8-PECDD	0.293	0.0440		
1,2,3,4,7,8-HXCDD	0.510	0.0440		
1,2,3,6,7,8-HXCDD	1.53	0.0440		
1,2,3,7,8,9-HXCDD	1.47	0.0440		
1,2,3,4,6,7,8-HPCDD	38.0	0.0560		
OCDD	324	0.190		
2,3,7,8-TCDF *	0.290	0.0440		
1,2,3,7,8-PECDF	0.384	0.0440		
2,3,4,7,8-PECDF	0.468	0.0440		
1,2,3,4,7,8-HXCDF	0.732	0.0440		
1,2,3,6,7,8-HXCDF	0.660	0.0440		
2,3,4,6,7,8-HXCDF	0.549	0.0440		
1,2,3,7,8,9-HXCDF	0.353	0.0440		
1,2,3,4,6,7,8-HPCDF	6.09	0.0440		
1,2,3,4,7,8,9-HPCDF	0.576	0.0440		
OCDF	8.46	0.0440		
TOTAL TETRA-DIOXINS	3.40	0.0440		
TOTAL PENTA-DIOXINS	3.03	0.0440		
TOTAL HEXA-DIOXINS	12.1	0.0440		
TOTAL HEPTA-DIOXINS	72.7	0.0560		
TOTAL TETRA-FURANS	8.08	0.0440		
TOTAL PENTA-FURANS	7.73	0.0440		
TOTAL HEXA-FURANS	12.3	0.0440		
TOTAL HEPTA-FURANS	15.1	0.0440		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	2.06
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	2.06

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	82.7
13C-1,2,3,7,8-PECDD	89.9
13C-1,2,3,6,7,8-HXCDD	74.9
13C-1,2,3,4,6,7,8-HPCDD	91.5
13C-OCDD	86.0
13C-2,3,7,8-TCDF	80.3
13C-1,2,3,7,8-PECDF	84.5
13C-1,2,3,4,7,8-HXCDF	73.3
13C-1,2,3,4,6,7,8-HPCDF	76.6

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** 05VN-127

**SAMPLE COLLECTION:** N/A

**CLIENT NO.:** 2607

**SAMPLE TYPE:** SEDIMENT

**SAMPLE SIZE:** 11.9 g (dry)

**% Moisture:** 25.1

**AXYS FILE:**

L7744-53 W

**REPORT DATE:** 07-Jun-2005

**METHOD NO.:** AXYS METHOD MLA-017 Rev 09

**EXTRACTION DATE:** 26-Apr-2005

**INSTRUMENT:** HR GC/MS

**ANALYSIS DATE:** 10-May-2005

**CONCENTRATION IN:** pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	1.83	0.0420		
1,2,3,7,8-PCDD	0.480	0.0420		
1,2,3,4,7,8-HxCDD	0.715	0.0700		
1,2,3,6,7,8-HxCDD	2.34	0.0700		
1,2,3,7,8,9-HxCDD	2.09	0.0700		
1,2,3,4,6,7,8-HPCDD	50.4	0.0790		
OCDD	426	0.0804		
2,3,7,8-TCDF *	0.357	0.0420		
1,2,3,7,8-PCDF	0.503	0.0420		
2,3,4,7,8-PCDF	0.603	0.0420		
1,2,3,4,7,8-HxCDF	1.03	0.0420		
1,2,3,6,7,8-HxCDF	0.736	0.0420		
2,3,4,6,7,8-HxCDF	0.564	0.0420		
1,2,3,7,8,9-HxCDF	0.207	0.0420		
1,2,3,4,6,7,8-HPCDF	7.07	0.0420		
1,2,3,4,7,8,9-HPCDF	0.504	0.0420		
OCDF	8.48	0.0420		
TOTAL TETRA-DIOXINS	4.11	0.0420		
TOTAL PENTA-DIOXINS	4.52	0.0420		
TOTAL HEXA-DIOXINS	20.0	0.0700		
TOTAL HEPTA-DIOXINS	107	0.0790		
TOTAL TETRA-FURANS	6.39	0.0590		
TOTAL PENTA-FURANS	8.25	0.0420		
TOTAL HEXA-FURANS	15.9	0.0420	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEPTA-FURANS	18.0	0.0420	2,3,7,8-TCDD TEQs (ND=0) =	4.06
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	4.06

**Surrogate Standards**

**% Recovery**

13C-2,3,7,8-TCDD	80.8
13C-1,2,3,7,8-PCDD	82.8
13C-1,2,3,6,7,8-HxCDD	79.7
13C-1,2,3,4,6,7,8-HPCDD	80.2
13C-OCDD	75.7
13C-2,3,7,8-TCDF	78.7
13C-1,2,3,7,8-PCDF	80.4
13C-1,2,3,4,7,8-HxCDF	78.9
13C-1,2,3,4,6,7,8-HPCDF	77.3

1. SDL = Sample Detection Limit
2. ND = Not detected
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4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-128	<b>AXYS FILE:</b>	L7744-54 LW
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	26-May-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SEDIMENT	<b>EXTRACTION DATE:</b>	24-Apr-2005
<b>SAMPLE SIZE:</b>	9.22 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
		<b>ANALYSIS DATE:</b>	19-May-2005
<b>% Moisture:</b>	77.2	<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	157	0.180	
1,2,3,7,8-PECDD	49.1	0.110	
1,2,3,4,7,8-HXCDD	60.7	0.920	
1,2,3,6,7,8-HXCDD	184	0.920	
1,2,3,7,8,9-HXCDD	178	0.920	
1,2,3,4,6,7,8-HPCDD	3740	2.04	
OCDD	37400	134	
2,3,7,8-TCDF *	36.9	0.977	
1,2,3,7,8-PECDF	39.8	0.550	
2,3,4,7,8-PECDF	40.5	0.550	
1,2,3,4,7,8-HXCDF	48.4	0.450	
1,2,3,6,7,8-HXCDF	108	0.450	
2,3,4,6,7,8-HXCDF	32.6	0.450	
1,2,3,7,8,9-HXCDF	14.9	0.450	
1,2,3,4,6,7,8-HPCDF	455	1.07	
1,2,3,4,7,8,9-HPCDF	55.2	1.07	
OCDF	1070	3.02	
TOTAL TETRA-DIOXINS	328	0.182	
TOTAL PENTA-DIOXINS	385	0.113	
TOTAL HEXA-DIOXINS	1640	0.920	
TOTAL HEPTA-DIOXINS	7630	2.04	
TOTAL TETRA-FURANS	501	1.91	
TOTAL PENTA-FURANS	555	0.550	
TOTAL HEXA-FURANS	873	0.450	
TOTAL HEPTA-FURANS	1330	1.07	
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>
			2,3,7,8-TCDD TEQs (ND=0) = 341
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 341

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	63.8
13C-1,2,3,7,8-PECDD	72.1
13C-1,2,3,6,7,8-HXCDD	61.0
13C-1,2,3,4,6,7,8-HPCDD	63.1
13C-OCDD	64.0
13C-2,3,7,8-TCDF	63.7
13C-1,2,3,7,8-PECDF	67.6
13C-1,2,3,4,7,8-HXCDF	60.2
13C-1,2,3,4,6,7,8-HPCDF	59.1

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist





**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	05VN-129	<b>AXYS FILE:</b>	L7744-55 (A)
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	26-May-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	24-Apr-2005
<b>SAMPLE SIZE:</b>	11.4 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
<b>% Moisture:</b>	0.99	<b>ANALYSIS DATE:</b>	07-May-2005
		<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	5.97	0.0440	
1,2,3,7,8-PECDD	2.82	0.0440	
1,2,3,4,7,8-HXCDD	4.44	0.0860	
1,2,3,6,7,8-HXCDD	16.0	0.0860	
1,2,3,7,8,9-HXCDD	12.0	0.0860	
1,2,3,4,6,7,8-HPCDD	416	0.250	
OCDD	4000	2.38	
2,3,7,8-TCDF *	1.57	0.0440	
1,2,3,7,8-PECDF	1.55	0.0440	
2,3,4,7,8-PECDF	2.36	0.0440	
1,2,3,4,7,8-HXCDF	5.63	0.0440	
1,2,3,6,7,8-HXCDF	3.45	0.0440	
2,3,4,6,7,8-HXCDF	2.89	0.0440	
1,2,3,7,8,9-HXCDF	0.434	0.0440	
1,2,3,4,6,7,8-HPCDF	55.7	0.0840	
1,2,3,4,7,8,9-HPCDF	2.70	0.0840	
OCDF	108	0.0544	
TOTAL TETRA-DIOXINS	12.1	0.0440	
TOTAL PENTA-DIOXINS	18.5	0.0440	
TOTAL HEXA-DIOXINS	112	0.0860	
TOTAL HEPTA-DIOXINS	817	0.250	
TOTAL TETRA-FURANS	18.8	0.0652	
TOTAL PENTA-FURANS	35.7	0.0440	
TOTAL HEXA-FURANS	91.5	0.0440	
TOTAL HEPTA-FURANS	146	0.0840	
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>
			2,3,7,8-TCDD TEQs (ND=0) = 19.8
			2,3,7,8-TCDD TEQs (ND=1/2 DL) = 19.8

**Surrogate Standards** **% Recovery**

13C-2,3,7,8-TCDD	64.8
13C-1,2,3,7,8-PECDD	76.4
13C-1,2,3,6,7,8-HXCDD	70.9
13C-1,2,3,4,6,7,8-HPCDD	71.2
13C-OCDD	79.0
13C-2,3,7,8-TCDF	63.9
13C-1,2,3,7,8-PECDF	71.9
13C-1,2,3,4,7,8-HXCDF	67.5
13C-1,2,3,4,6,7,8-HPCDF	70.3

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE ID.:</b>	05VN-129 (Duplicate)	<b>AXYS FILE:</b>	WG15627-103 (DUP L7744-55)
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	26-May-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SOIL	<b>EXTRACTION DATE:</b>	24-Apr-2005
<b>SAMPLE SIZE:</b>	10.3 g (dry)	<b>INSTRUMENT:</b>	HR GC/MS
		<b>ANALYSIS DATE:</b>	07-May-2005
<b>% Moisture:</b>	3.95	<b>CONCENTRATION IN:</b>	pg/g (dry weight basis)

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	5.20	0.0490		
1,2,3,7,8-PECDD	2.79	0.0490		
1,2,3,4,7,8-HxCDD	4.14	0.100		
1,2,3,6,7,8-HxCDD	15.0	0.100		
1,2,3,7,8,9-HxCDD	11.0	0.100		
1,2,3,4,6,7,8-HPCDD	385	0.200		
OCDD	3650	0.0662		
2,3,7,8-TCDF *	1.74	0.0490		
1,2,3,7,8-PECDF	1.47	0.0490		
2,3,4,7,8-PECDF	2.33	0.0490		
1,2,3,4,7,8-HxCDF	5.44	0.240		
1,2,3,6,7,8-HxCDF	3.18	0.240		
2,3,4,6,7,8-HxCDF	2.86	0.240		
1,2,3,7,8,9-HxCDF	0.413	0.240		
1,2,3,4,6,7,8-HPCDF	52.5	0.0730		
1,2,3,4,7,8,9-HPCDF	2.52	0.0730		
OCDF	102	0.0490		
TOTAL TETRA-DIOXINS	10.7	0.0490		
TOTAL PENTA-DIOXINS	18.8	0.0490		
TOTAL HEXA-DIOXINS	106	0.100		
TOTAL HEPTA-DIOXINS	768	0.200		
TOTAL TETRA-FURANS	20.8	0.0744		
TOTAL PENTA-FURANS	34.8	0.0490		
TOTAL HEXA-FURANS	85.9	0.240		
TOTAL HEPTA-FURANS	138	0.0730		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	18.4
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	18.4

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	80.0
13C-1,2,3,7,8-PECDD	101
13C-1,2,3,6,7,8-HxCDD	96.5
13C-1,2,3,4,6,7,8-HPCDD	94.8
13C-OCDD	96.3
13C-2,3,7,8-TCDF	76.6
13C-1,2,3,7,8-PECDF	91.4
13C-1,2,3,4,7,8-HxCDF	91.0
13C-1,2,3,4,6,7,8-HPCDF	90.9

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist



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## **Appendix A4.8**

### **Dioxin Data: QA/QC Sheets**

- **Batch Summaries**
  - **Lab Blanks**
  - **Spiked Matrices**
-

# BATCH SUMMARY

<b>Batch ID:</b> DXWG16946	<b>Date:</b> 27-Oct-2005														
<b>Analysis Type:</b> Dioxin/Furan	<b>Matrix Type:</b> Sediments & Soils														
<b>BATCH MAKEUP</b>															
<b>Contract:</b> 2607 <b>Samples:</b> <table border="1"> <thead> <tr> <th>AXYS ID</th> <th>Client ID</th> </tr> </thead> <tbody> <tr><td>L8155-2</td><td>05VN-003</td></tr> <tr><td>L8155-3</td><td>05VN-011</td></tr> <tr><td>L8155-4</td><td>05VN-012</td></tr> <tr><td>L8155-5</td><td>05VN-013</td></tr> <tr><td>L8155-6</td><td>05VN-015</td></tr> <tr><td>L8155-7</td><td>05VN-018</td></tr> </tbody> </table>	AXYS ID	Client ID	L8155-2	05VN-003	L8155-3	05VN-011	L8155-4	05VN-012	L8155-5	05VN-013	L8155-6	05VN-015	L8155-7	05VN-018	<b>Blank:</b>  <div style="text-align: center;">WG16946-101</div>
AXYS ID	Client ID														
L8155-2	05VN-003														
L8155-3	05VN-011														
L8155-4	05VN-012														
L8155-5	05VN-013														
L8155-6	05VN-015														
L8155-7	05VN-018														
	<b>Reference or Spike:</b>  <div style="text-align: center;">WG16946-102</div>														
	<b>Duplicate:</b>  <div style="text-align: center;">WG16946-103</div>														
<b>Comments:</b>  <ol style="list-style-type: none"> <li>Data are not blank corrected, and field samples should be evaluated in comparison to the lab blank. In the lab blank, levels of 1,2,3,4,6,7,8-HpCDD and -HpCDF, and OCDD and OCDF, were above method criteria. The samples reported from this workgroup have concentrations of these analytes at least ten times higher than those in the lab blank (with the exception of 1,2,3,4,6,7,8-HpCDF and OCDF in sample 05VN-015, AXYS ID L8155-6).</li> </ol>															

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**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

CLIENT SAMPLE I.D.: Lab Blank  
SAMPLE COLLECTION: N/A  
CLIENT NO.: 2607  
PROJECT NO.: N/A  
SAMPLE TYPE: SOLID  
SAMPLE SIZE: 10.0 g

AXYS FILE: WG16946-101  
REPORT DATE: 26-Oct-2005  
METHOD NO.: AXYS METHOD MLA-017 Rev 10  
EXTRACTION DATE: 20-Sep-2005  
INSTRUMENT: HR GC/MS  
ANALYSIS DATE: 03-Oct-2005  
CONCENTRATION IN: pg/g

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	ND	0.0500		
1,2,3,7,8-PECDD	ND	0.0500		
1,2,3,4,7,8-HXCDD	ND	0.0800		
1,2,3,6,7,8-HXCDD	0.123	0.0800		
1,2,3,7,8,9-HXCDD	ND	0.0800		
1,2,3,4,6,7,8-HPCDD	5.87	0.154		
OCDD	88.0	0.188		
2,3,7,8-TCDF *	ND	0.0500		
1,2,3,7,8-PECDF	ND	0.0500		
2,3,4,7,8-PECDF	ND	0.0500		
1,2,3,4,7,8-HXCDF	ND	0.0500		
1,2,3,6,7,8-HXCDF	ND	0.0500		
2,3,4,6,7,8-HXCDF	ND	0.0500		
1,2,3,7,8,9-HXCDF	ND	0.0500		
1,2,3,4,6,7,8-HPCDF	1.04	0.0700		
1,2,3,4,7,8,9-HPCDF	ND	0.0700		
OCDF	1.72	0.0500		
TOTAL TETRA-DIOXINS	ND	0.0500		
TOTAL PENTA-DIOXINS	0.171	0.0500		
TOTAL HEXA-DIOXINS	1.04	0.0800		
TOTAL HEPTA-DIOXINS	12.7	0.154		
TOTAL TETRA-FURANS	ND	0.0500		
TOTAL PENTA-FURANS	ND	0.0500		
TOTAL HEXA-FURANS	0.933	0.0500	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEPTA-FURANS	3.69	0.0700	2,3,7,8-TCDD TEQs (ND=0) =	0.090
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	0.175

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	79.0
13C-1,2,3,7,8-PECDD	80.6
13C-1,2,3,6,7,8-HXCDD	81.0
13C-1,2,3,4,6,7,8-HPCDD	76.4
13C-OCDD	63.3
13C-2,3,7,8-TCDF	72.7
13C-1,2,3,7,8-PECDF	78.4
13C-1,2,3,4,7,8-HXCDF	77.2
13C-1,2,3,4,6,7,8-HPCDF	72.8

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

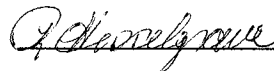
<b>CLIENT SAMPLE I.D.:</b>	Spiked Matrix	<b>AXYS FILE:</b>	WG16946-102
<b>CLIENT NO.:</b>	2607	<b>REPORT DATE:</b>	26-Oct-2005
<b>SAMPLE TYPE:</b>	SOLID	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>SAMPLE SIZE:</b>	10.0 g	<b>INSTRUMENT:</b>	HR GC/MS
		<b>CONCENTRATION IN:</b>	pg/g

COMPOUND	Determined	Expected	% Recovery
2,3,7,8-TCDD	9.60	10.0	96.0
1,2,3,7,8-PECDD	49.8	50.0	99.6
1,2,3,4,7,8-HXCDD	48.5	50.0	97.0
1,2,3,6,7,8-HXCDD	50.3	50.0	101
1,2,3,7,8,9-HXCDD	50.8	50.0	102
1,2,3,4,6,7,8-HPCDD	49.2	50.0	98.4
OCDD	101	100	101
2,3,7,8-TCDF	10.1	10.0	101
1,2,3,7,8-PECDF	48.4	50.0	96.9
2,3,4,7,8-PECDF	45.3	50.0	90.6
1,2,3,4,7,8-HXCDF	48.6	50.0	97.1
1,2,3,6,7,8-HXCDF	50.8	50.0	102
2,3,4,6,7,8-HXCDF	48.0	50.0	96.1
1,2,3,7,8,9-HXCDF	51.2	50.0	102
1,2,3,4,6,7,8-HPCDF	54.1	50.0	108
1,2,3,4,7,8,9-HPCDF	50.9	50.0	102
OCDF	101	100	101

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	52.6
13C-1,2,3,7,8-PECDD	51.1
13C-1,2,3,6,7,8-HXCDD	54.2
13C-1,2,3,4,6,7,8-HPCDD	53.9
13C-OCDD	56.7
13C-2,3,7,8-TCDF	50.0
13C-1,2,3,7,8-PECDF	55.3
13C-1,2,3,4,7,8-HXCDF	54.1
13C-1,2,3,4,6,7,8-HPCDF	50.6

1. Concentrations are recovery corrected

Approved:



QA/QC Chemist

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Report Filename: AXYS\_DIOXINS\_AXYSDB5\_WG16946-102\_SJ472192.html; Workgroup: WG16946; Design ID: 194 ]



# BATCH SUMMARY

<b>Batch ID:</b> DXWG14801	<b>Date:</b> 19-Jan-2002
<b>Analysis Type:</b> Dioxin/Furan	<b>Matrix Type:</b> Solid
<b>BATCH MAKEUP</b>	
<b>Contract:</b> 2607 <b>Samples:</b> L7508-1	<b>Blank:</b>  WG14801-101
	<b>Reference or Spike:</b>  WG14801-102
	<b>Duplicate:</b>
<b>Comments:</b>  1.	

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# BATCH SUMMARY

<b>Batch ID:</b> DXWG15019	<b>Date:</b> 26-May-2005
<b>Analysis Type:</b> Dioxin/Furan	<b>Matrix Type:</b> Sediments & Soils
<b>BATCH MAKEUP</b>	
<b>Contract:</b> 2607 <b>Samples:</b> L7508-2 L7508-3 L7508-4 L7508-5	<b>Blank:</b>  WG15019-101
	<b>Reference or Spike:</b>  WG15019-102
	<b>Duplicate:</b>  
<b>Comments:</b>  1. Data are not blank corrected. 2. Sample 04VN-001 (AXYS ID L7508-1) was previously reported. 3. Results for the Lab Blank from the initial analysis of these samples did not meet the method performance criteria. Repeat analysis of the samples was performed from a backup portion of the original extract, indicated by the suffix RX added to the AXYS ID on the reports. The extracts were spiked with labeled quantification standards after extraction; data are therefore not recovery-corrected for potential losses during the extraction process. Results from the repeat analysis met all method performance criteria.	

**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	Lab Blank	<b>AXYS FILE:</b>	WG14801-101
<b>SAMPLE COLLECTION:</b>	N/A		
<b>CLIENT NO.:</b>	2607	<b>REPORT DATE:</b>	22-Feb-2005
<b>PROJECT NO.:</b>	N/A	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SOLID	<b>EXTRACTION DATE:</b>	18-Jan-2005
<b>SAMPLE SIZE:</b>	5.00 g	<b>INSTRUMENT:</b>	HR GC/MS
		<b>ANALYSIS DATE:</b>	29-Jan-2005
		<b>CONCENTRATION IN:</b>	pg/g

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	ND	0.100		
1,2,3,7,8-PECDD	ND	0.100		
1,2,3,4,7,8-HXCDD	ND	0.100		
1,2,3,6,7,8-HXCDD	ND	0.100		
1,2,3,7,8,9-HXCDD	ND	0.100		
1,2,3,4,6,7,8-HPCDD	0.278	0.100		
OCDD	1.14	0.100		
2,3,7,8-TCDF	ND	0.100		
1,2,3,7,8-PECDF	ND	0.100		
2,3,4,7,8-PECDF	0.117	0.100		
1,2,3,4,7,8-HXCDF	ND	0.100		
1,2,3,6,7,8-HXCDF	ND	0.100		
2,3,4,6,7,8-HXCDF	ND	0.100		
1,2,3,7,8,9-HXCDF	ND	0.100		
1,2,3,4,6,7,8-HPCDF	0.139	0.100		
1,2,3,4,7,8,9-HPCDF	0.131	0.100		
OCDF	0.439	0.100		
TOTAL TETRA-DIOXINS	ND	0.100		
TOTAL PENTA-DIOXINS	ND	0.100		
TOTAL HEXA-DIOXINS	ND	0.100		
TOTAL HEPTA-DIOXINS	0.422	0.100		
TOTAL TETRA-FURANS	ND	0.100		
TOTAL PENTA-FURANS	0.117	0.100	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEXA-FURANS	ND	0.100	2,3,7,8-TCDD TEQs (ND=0) =	0.064
TOTAL HEPTA-FURANS	0.270	0.100	2,3,7,8-TCDD TEQs (ND=1/2 DL) =	0.207

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	77.3
13C-1,2,3,7,8-PECDD	85.9
13C-1,2,3,6,7,8-HXCDD	78.2
13C-1,2,3,4,6,7,8-HPCDD	68.0
13C-OCDD	49.4
13C-2,3,7,8-TCDF	76.7
13C-1,2,3,7,8-PECDF	79.1
13C-1,2,3,4,7,8-HXCDF	81.9
13C-1,2,3,4,6,7,8-HPCDF	67.7

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

CLIENT SAMPLE I.D.:	Spiked Matrix	AXYS FILE:	WG14801-102
CLIENT NO.:	2607	REPORT DATE:	22-Feb-2005
SAMPLE TYPE:	SOLID	METHOD NO.:	AXYS METHOD MLA-017 Rev 09
SAMPLE SIZE:	10.0 g	INSTRUMENT:	HR GC/MS
		CONCENTRATION IN:	pg/g

COMPOUND	Determined	Expected	% Recovery
2,3,7,8-TCDD	9.40	10.0	94.0
1,2,3,7,8-PECDD	48.9	50.0	97.9
1,2,3,4,7,8-HXCDD	51.7	50.0	103
1,2,3,6,7,8-HXCDD	49.5	50.0	99.0
1,2,3,7,8,9-HXCDD	41.8	50.0	83.6
1,2,3,4,6,7,8-HPCDD	48.4	50.0	96.9
OCDD	97.1	100	97.1
2,3,7,8-TCDF	9.78	10.0	97.8
1,2,3,7,8-PECDF	47.3	50.0	94.7
2,3,4,7,8-PECDF	49.7	50.0	99.4
1,2,3,4,7,8-HXCDF	48.5	50.0	97.1
1,2,3,6,7,8-HXCDF	49.1	50.0	98.2
2,3,4,6,7,8-HXCDF	41.9	50.0	83.9
1,2,3,7,8,9-HXCDF	40.3	50.0	80.6
1,2,3,4,6,7,8-HPCDF	49.6	50.0	99.2
1,2,3,4,7,8,9-HPCDF	43.2	50.0	86.5
OCDF	115	100	115

Surrogate Standards	% Recovery
---------------------	------------

13C-2,3,7,8-TCDD	59.3
13C-1,2,3,7,8-PECDD	75.7
13C-1,2,3,6,7,8-HXCDD	65.1
13C-1,2,3,4,6,7,8-HPCDD	51.6
13C-OCDD	32.1
13C-2,3,7,8-TCDF	58.1
13C-1,2,3,7,8-PECDF	67.6
13C-1,2,3,4,7,8-HXCDF	68.9
13C-1,2,3,4,6,7,8-HPCDF	58.3

1. Concentrations are recovery corrected

Approved:



QA/QC Chemist

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Report Filename: AXYS\_DIOXINS\_AXYSDB5\_WG14801-102\_SJ370296.html; Workgroup: WG14801; Design ID: 194 ]



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	Lab Blank	<b>AXYS FILE:</b>	WG15019-101
<b>SAMPLE COLLECTION:</b>	N/A		
<b>CLIENT NO.:</b>	2607	<b>REPORT DATE:</b>	26-May-2005
<b>PROJECT NO.:</b>	N/A	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE TYPE:</b>	SOLID	<b>EXTRACTION DATE:</b>	18-Jan-2005
<b>SAMPLE SIZE:</b>	5.00 g	<b>INSTRUMENT:</b>	HR GC/MS
		<b>ANALYSIS DATE:</b>	09-Mar-2005
		<b>CONCENTRATION IN:</b>	pg/g

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	ND	0.100	
1,2,3,7,8-PECDD	ND	0.100	
1,2,3,4,7,8-HXCDD	ND	0.100	
1,2,3,6,7,8-HXCDD	ND	0.100	
1,2,3,7,8,9-HXCDD	ND	0.100	
1,2,3,4,6,7,8-HPCDD	0.155	0.100	
OCDD	0.531	0.100	
2,3,7,8-TCDF *	ND	0.100	
1,2,3,7,8-PECDF	ND	0.100	
2,3,4,7,8-PECDF	ND	0.100	
1,2,3,4,7,8-HXCDF	ND	0.100	
1,2,3,6,7,8-HXCDF	ND	0.100	
2,3,4,6,7,8-HXCDF	ND	0.100	
1,2,3,7,8,9-HXCDF	ND	0.100	
1,2,3,4,6,7,8-HPCDF	ND	0.100	
1,2,3,4,7,8,9-HPCDF	ND	0.100	
OCDF	0.217	0.100	
TOTAL TETRA-DIOXINS	ND	0.100	
TOTAL PENTA-DIOXINS	ND	0.100	
TOTAL HEXA-DIOXINS	ND	0.100	
TOTAL HEPTA-DIOXINS	0.155	0.100	
TOTAL TETRA-FURANS	ND	0.100	
TOTAL PENTA-FURANS	ND	0.100	
TOTAL HEXA-FURANS	ND	0.100	
TOTAL HEPTA-FURANS	ND	0.100	
		<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
		2,3,7,8-TCDD TEQs (ND=0) =	0.002
		2,3,7,8-TCDD TEQs (ND=1/2 DL) =	0.170

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	92.1
13C-1,2,3,7,8-PECDD	96.1
13C-1,2,3,6,7,8-HXCDD	99.5
13C-1,2,3,4,6,7,8-HPCDD	92.2
13C-OCDD	84.1
13C-2,3,7,8-TCDF	86.1
13C-1,2,3,7,8-PECDF	91.6
13C-1,2,3,4,7,8-HXCDF	94.3
13C-1,2,3,4,6,7,8-HPCDF	91.0

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*[Signature]*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	Spiked Matrix	<b>AXYS FILE:</b>	WG15019-102
<b>CLIENT NO.:</b>	2607	<b>REPORT DATE:</b>	26-May-2005
<b>SAMPLE TYPE:</b>	SOLID	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE SIZE:</b>	10.0 g	<b>INSTRUMENT:</b>	HR GC/MS
		<b>CONCENTRATION IN:</b>	pg/g

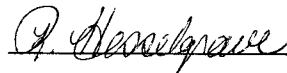
COMPOUND	Determined	Expected	% Recovery
2,3,7,8-TCDD	9.29	10.0	92.9
1,2,3,7,8-PECDD	49.1	50.0	98.3
1,2,3,4,7,8-HXCDD	50.1	50.0	100
1,2,3,6,7,8-HXCDD	49.3	50.0	98.6
1,2,3,7,8,9-HXCDD	49.6	50.0	99.3
1,2,3,4,6,7,8-HPCDD	49.7	50.0	99.5
OCDD	98.8	100	98.8
2,3,7,8-TCDF	9.98	10.0	99.8
1,2,3,7,8-PECDF	49.4	50.0	98.8
2,3,4,7,8-PECDF	49.4	50.0	98.9
1,2,3,4,7,8-HXCDF	49.4	50.0	98.8
1,2,3,6,7,8-HXCDF	50.6	50.0	101
2,3,4,6,7,8-HXCDF	49.8	50.0	99.6
1,2,3,7,8,9-HXCDF	54.6	50.0	109
1,2,3,4,6,7,8-HPCDF	49.9	50.0	99.8
1,2,3,4,7,8,9-HPCDF	50.9	50.0	102
OCDF	101	100	101

Surrogate Standards	% Recovery
---------------------	------------

13C-2,3,7,8-TCDD	87.3
13C-1,2,3,7,8-PECDD	94.8
13C-1,2,3,6,7,8-HXCDD	90.7
13C-1,2,3,4,6,7,8-HPCDD	89.8
13C-OCDD	83.9
13C-2,3,7,8-TCDF	85.1
13C-1,2,3,7,8-PECDF	90.6
13C-1,2,3,4,7,8-HXCDF	89.9
13C-1,2,3,4,6,7,8-HPCDF	88.7

1. Concentrations are recovery corrected

Approved:



QA/QC Chemist

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Report Filename: AXYS\_DIOXINS\_AXYSDB5\_WG15019-102\_SJ392523.html; Workgroup: WG15019; Design ID: 194 ]



# BATCH SUMMARY

<b>Batch ID:</b> DXWG15629	<b>Date:</b> 7-Jun-2005
<b>Analysis Type:</b> Dioxin/Furan	<b>Matrix Type:</b> Sediments & Soils
<b>BATCH MAKEUP</b>	
<b>Contract:</b> 2607 <b>Samples:</b> L7744-50 L7744-51 L7744-52 L7744-53	<b>Blank:</b>  WG15629-101
	<b>Reference or Spike:</b>  WG15629-102
	<b>Duplicate:</b>
<b>Comments:</b>  1. Data are not blank corrected.	

# BATCH SUMMARY

<b>Batch ID:</b> DXWG15681	<b>Date:</b> 11-Jul-2005
<b>Analysis Type:</b> Dioxin/Furan	<b>Matrix Type:</b> Sediment
<b>BATCH MAKEUP</b>	
<b>Contract:</b> 2607 <b>Samples:</b> L7744-49	<b>Blank:</b> WG15681-101
	<b>Reference or Spike:</b> WG15681-102
	<b>Duplicate:</b>
<b>Comments:</b>  1. Data are not blank corrected. 2. This sample 05VN-116 (AXYS ID L7744-49 R) is a repeat sample, as indicated by the suffix "R" added to the AXYS ID on the report.	

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# BATCH SUMMARY

<b>Batch ID:</b> DXWG15628	<b>Date:</b> 15-Jun-2005
<b>Analysis Type:</b> Dioxin/Furan	<b>Matrix Type:</b> Sediments & Soils
<b>BATCH MAKEUP</b>	
<b>Contract:</b> 2607 <b>Samples:</b>  L7744-21 L7744-44 L7744-22 L7744-46 L7744-23 L7744-47 L7744-24 L7744-48 L7744-25 L7744-26 L7744-27 L7744-31 L7744-32 L7744-33 L7744-37 L7744-38 L7744-39 L7744-40 L7744-41	<b>Blank:</b>  WG15628-101  <b>Reference or Spike:</b>  WG15628-102  <b>Duplicate:</b>  WG15628-103
<b>Comments:</b>  1. Data are not blank corrected.	

# BATCH SUMMARY

<b>Batch ID:</b> DXWG15626	<b>Date:</b> 11-Jun-2005
<b>Analysis Type:</b> Dioxin/Furan	<b>Matrix Type:</b> Sediments & Soils
<b>BATCH MAKEUP</b>	
<b>Contract:</b> 2607 <b>Samples:</b> L7744-1 L7744-2 L7744-3 L7744-4 L7744-5 L7744-6 L7744-7 L7744-8 L7744-9 L7744-10 L7744-11 L7744-12 L7744-13 L7744-14 L7744-15 L7744-16 L7744-17 L7744-18 L7744-19 L7744-20	<b>Blank:</b>  WG15626-101
	<b>Reference or Spike:</b>  WG15626-102
	<b>Duplicate:</b>  WG15626-103
<b>Comments:</b>  1. Data are not blank corrected, and field samples should be evaluated in comparison to the procedural blank. The blank has been quantified on a mid-range sample size. For the most accurate comparison between an individual sample and the blank, the blank results may be prorated to the size of the sample in question.	

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# BATCH SUMMARY

<b>Batch ID:</b> DXWG15727	<b>Date:</b> 7-Jun-2005
<b>Analysis Type:</b> Dioxin/Furan	<b>Matrix Type:</b> Sediments & Soils
<b>BATCH MAKEUP</b>	
<b>Contract:</b> 2607 <b>Samples:</b> L7744-35 L7744-36 L7748-5 ↳ already sent	<b>Blank:</b>  WG15727-101
	<b>Reference or Spike:</b>  WG15727-102
	<b>Duplicate:</b>
<b>Comments:</b>  1. Data are not blank corrected. 2. Data for sample L7748-5 was previously submitted as "preliminary data". Data for sample L7748-5 submitted here is described as "final data". Preliminary and final data are in good agreement.	

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**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** Lab Blank  
**SAMPLE COLLECTION:** N/A  
**CLIENT NO.:** 2607  
**PROJECT NO.:** N/A  
**SAMPLE TYPE:** SOLID  
**SAMPLE SIZE:** 10.0 g

**AXYS FILE:** WG15626-101 i  
**REPORT DATE:** 11-Jun-2005  
**METHOD NO.:** AXYS METHOD MLA-017 Rev 09  
**EXTRACTION DATE:** 27-Apr-2005  
**INSTRUMENT:** HR GC/MS  
**ANALYSIS DATE:** 11-May-2005  
**CONCENTRATION IN:** pg/g

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	ND	0.0500	
1,2,3,7,8-PECDD	0.073	0.0500	
1,2,3,4,7,8-HXCDD	0.068	0.0500	
1,2,3,6,7,8-HXCDD	NDR (0.077)	0.0500	
1,2,3,7,8,9-HXCDD	0.094	0.0500	
1,2,3,4,6,7,8-HPCDD	0.170	0.0500	
OCDD	0.262	0.0500	
2,3,7,8-TCDF *	ND	0.0500	
1,2,3,7,8-PECDF	0.071	0.0500	
2,3,4,7,8-PECDF	0.124	0.0500	
1,2,3,4,7,8-HXCDF	0.070	0.0500	
1,2,3,6,7,8-HXCDF	0.071	0.0500	
2,3,4,6,7,8-HXCDF	NDR (0.075)	0.0500	
1,2,3,7,8,9-HXCDF	0.113	0.0500	
1,2,3,4,6,7,8-HPCDF	0.104	0.0500	
1,2,3,4,7,8,9-HPCDF	0.107	0.0500	
OCDF	0.244	0.0500	
TOTAL TETRA-DIOXINS	ND	0.0500	
TOTAL PENTA-DIOXINS	0.073	0.0500	
TOTAL HEXA-DIOXINS	0.162	0.0500	
TOTAL HEPTA-DIOXINS	0.234	0.0500	
TOTAL TETRA-FURANS	0.050	0.0500	
TOTAL PENTA-FURANS	0.195	0.0500	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)
TOTAL HEXA-FURANS	0.254	0.0500	2,3,7,8-TCDD TEQs (ND=0) = 0.184
TOTAL HEPTA-FURANS	0.211	0.0500	2,3,7,8-TCDD TEQs (ND=1/2 DL) = 0.217

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	76.7
13C-1,2,3,7,8-PECDD	90.1
13C-1,2,3,6,7,8-HXCDD	89.3
13C-1,2,3,4,6,7,8-HPCDD	79.4
13C-OCDD	77.1
13C-2,3,7,8-TCDF	76.7
13C-1,2,3,7,8-PECDF	81.1
13C-1,2,3,4,7,8-HXCDF	93.3
13C-1,2,3,4,6,7,8-HPCDF	81.8

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*B. Waters*

QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE ID.:** Lab Blank  
**SAMPLE COLLECTION:** N/A  
**CLIENT NO.:** 2607  
**PROJECT NO.:** N/A  
**SAMPLE TYPE:** SOLID  
**SAMPLE SIZE:** 10.0 g

**AXYS FILE:** WG15627-101 i  
**REPORT DATE:** 26-May-2005  
**METHOD NO.:** AXYS METHOD MLA-017 Rev 09  
**EXTRACTION DATE:** 24-Apr-2005  
**INSTRUMENT:** HR GC/MS  
**ANALYSIS DATE:** 06-May-2005  
**CONCENTRATION IN:** pg/g

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	ND	0.0500	
1,2,3,7,8-PECDD	ND	0.0500	
1,2,3,4,7,8-HXCDD	ND	0.0500	
1,2,3,6,7,8-HXCDD	ND	0.0500	
1,2,3,7,8,9-HXCDD	0.068	0.0500	
1,2,3,4,6,7,8-HPCDD	0.107	0.0500	
OCDD	0.353	0.0500	
2,3,7,8-TCDF *	ND	0.0500	
1,2,3,7,8-PECDF	ND	0.0500	
2,3,4,7,8-PECDF	0.059	0.0500	
1,2,3,4,7,8-HXCDF	ND	0.0500	
1,2,3,6,7,8-HXCDF	ND	0.0500	
2,3,4,6,7,8-HXCDF	ND	0.0500	
1,2,3,7,8,9-HXCDF	NDR (0.060)	0.0500	
1,2,3,4,6,7,8-HPCDF	ND	0.0500	
1,2,3,4,7,8,9-HPCDF	0.050	0.0500	
OCDF	0.110	0.0500	
TOTAL TETRA-DIOXINS	ND	0.0500	
TOTAL PENTA-DIOXINS	ND	0.0500	
TOTAL HEXA-DIOXINS	0.068	0.0500	
TOTAL HEPTA-DIOXINS	0.170	0.0500	
TOTAL TETRA-FURANS	ND	0.0500	
TOTAL PENTA-FURANS	0.059	0.0500	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)
TOTAL HEXA-FURANS	ND	0.0500	2,3,7,8-TCDD TEQs (ND=0) = 0.038
TOTAL HEPTA-FURANS	0.050	0.0500	2,3,7,8-TCDD TEQs (ND=1/2 DL) = 0.107

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	84.8
13C-1,2,3,7,8-PECDD	96.9
13C-1,2,3,6,7,8-HXCDD	90.7
13C-1,2,3,4,6,7,8-HPCDD	85.4
13C-OCDD	90.5
13C-2,3,7,8-TCDF	84.5
13C-1,2,3,7,8-PECDF	90.7
13C-1,2,3,4,7,8-HXCDF	92.1
13C-1,2,3,4,6,7,8-HPCDF	91.6

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_



QA/QC Chemist

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Report Filename: AXYS\_DIOXINS\_AXYSDB5\_WG15627-101\_SJ414572.html; Workgroup: WG15627; Design ID: 194 ]



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** Lab Blank  
**SAMPLE COLLECTION:** N/A  
**CLIENT NO.:** 2607  
**PROJECT NO.:** N/A  
**SAMPLE TYPE:** SOLID  
**SAMPLE SIZE:** 10.0 g  
  
**% Moisture:** 0

**AXYS FILE:** WG15628-101  
  
**REPORT DATE:** 14-Jun-2005  
**METHOD NO.:** AXYS METHOD MLA-017 Rev 09  
**EXTRACTION DATE:** 28-Apr-2005  
**INSTRUMENT:** HR GC/MS  
**ANALYSIS DATE:** 14-May-2005  
**CONCENTRATION IN:** pg/g

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	ND	0.0500		
1,2,3,7,8-PECDD	ND	0.0500		
1,2,3,4,7,8-HXCDD	ND	0.0500		
1,2,3,6,7,8-HXCDD	ND	0.0500		
1,2,3,7,8,9-HXCDD	ND	0.0500		
1,2,3,4,6,7,8-HPCDD	NDR (0.055)	0.0500		
OCDD	0.146	0.0500		
2,3,7,8-TCDF *	ND	0.0500		
1,2,3,7,8-PECDF	ND	0.0500		
2,3,4,7,8-PECDF	ND	0.0500		
1,2,3,4,7,8-HXCDF	ND	0.0500		
1,2,3,6,7,8-HXCDF	ND	0.0500		
2,3,4,6,7,8-HXCDF	ND	0.0500		
1,2,3,7,8,9-HXCDF	ND	0.0500		
1,2,3,4,6,7,8-HPCDF	ND	0.0500		
1,2,3,4,7,8,9-HPCDF	ND	0.0500		
OCDF	ND	0.0500		
TOTAL TETRA-DIOXINS	ND	0.0500		
TOTAL PENTA-DIOXINS	ND	0.0500		
TOTAL HEXA-DIOXINS	ND	0.0500		
TOTAL HEPTA-DIOXINS	ND	0.0500		
TOTAL TETRA-FURANS	ND	0.0500		
TOTAL PENTA-FURANS	ND	0.0500		
TOTAL HEXA-FURANS	ND	0.0500		
TOTAL HEPTA-FURANS	ND	0.0500		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	0.000
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	0.085

**Surrogate Standards** **% Recovery**

13C-2,3,7,8-TCDD	94.2
13C-1,2,3,7,8-PECDD	99.0
13C-1,2,3,6,7,8-HXCDD	90.9
13C-1,2,3,4,6,7,8-HPCDD	82.8
13C-OCDD	77.2
13C-2,3,7,8-TCDF	90.1
13C-1,2,3,7,8-PECDF	95.2
13C-1,2,3,4,7,8-HXCDF	90.4
13C-1,2,3,4,6,7,8-HPCDF	78.8

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*Paul H. K.*

QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** Lab Blank  
**SAMPLE COLLECTION:** N/A  
**CLIENT NO.:** 2607  
**PROJECT NO.:** N/A  
**SAMPLE TYPE:** SOLID  
**SAMPLE SIZE:** 10.0 g

**AXYS FILE:** WG15629-101  
**REPORT DATE:** 07-Jun-2005  
**METHOD NO.:** AXYS METHOD MLA-017 Rev 09  
**EXTRACTION DATE:** 26-Apr-2005  
**INSTRUMENT:** HR GC/MS  
**ANALYSIS DATE:** 03-May-2005  
**CONCENTRATION IN:** pg/g

COMPOUND	Concentration	(SDL)	
2,3,7,8-TCDD	ND	0.0500	
1,2,3,7,8-PECDD	ND	0.0500	
1,2,3,4,7,8-HXCDD	ND	0.0500	
1,2,3,6,7,8-HXCDD	ND	0.0500	
1,2,3,7,8,9-HXCDD	0.057	0.0500	
1,2,3,4,6,7,8-HPCDD	0.095	0.0500	
OCDD	NDR (0.124)	0.0500	
2,3,7,8-TCDF *	ND	0.0500	
1,2,3,7,8-PECDF	ND	0.0500	
2,3,4,7,8-PECDF	0.051	0.0500	
1,2,3,4,7,8-HXCDF	ND	0.0500	
1,2,3,6,7,8-HXCDF	ND	0.0500	
2,3,4,6,7,8-HXCDF	ND	0.0500	
1,2,3,7,8,9-HXCDF	0.054	0.0500	
1,2,3,4,6,7,8-HPCDF	ND	0.0500	
1,2,3,4,7,8,9-HPCDF	NDR (0.058)	0.0500	
OCDF	0.085	0.0500	
TOTAL TETRA-DIOXINS	ND	0.0500	
TOTAL PENTA-DIOXINS	ND	0.0500	
TOTAL HEXA-DIOXINS	0.057	0.0500	
TOTAL HEPTA-DIOXINS	0.095	0.0500	
TOTAL TETRA-FURANS	ND	0.0500	
TOTAL PENTA-FURANS	0.051	0.0500	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)
TOTAL HEXA-FURANS	0.054	0.0500	2,3,7,8-TCDD TEQs (ND=0) = 0.038
TOTAL HEPTA-FURANS	ND	0.0500	2,3,7,8-TCDD TEQs (ND=1/2 DL) = 0.104

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	81.1
13C-1,2,3,7,8-PECDD	85.9
13C-1,2,3,6,7,8-HXCDD	81.0
13C-1,2,3,4,6,7,8-HPCDD	79.9
13C-OCDD	75.6
13C-2,3,7,8-TCDF	81.7
13C-1,2,3,7,8-PECDF	81.9
13C-1,2,3,4,7,8-HXCDF	77.4
13C-1,2,3,4,6,7,8-HPCDF	76.8

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist





**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** Lab Blank

**AXYS FILE:** WG15681-101 :2PT

**SAMPLE COLLECTION:** N/A

**CLIENT NO.:** 2607

**REPORT DATE:** 28-Jun-2005

**PROJECT NO.:** N/A

**METHOD NO.:** AXYS METHOD MLA-017 Rev 10

**SAMPLE TYPE:** SOLID

**EXTRACTION DATE:** 10-Jun-2005

**SAMPLE SIZE:** 10.0 g

**INSTRUMENT:** HR GC/MS

**ANALYSIS DATE:** 21-Jun-2005

**% Moisture:** 0.57

**CONCENTRATION IN:** pg/g

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	ND	0.0500		
1,2,3,7,8-PECDD	ND	0.0500		
1,2,3,4,7,8-HXCDD	ND	0.0500		
1,2,3,6,7,8-HXCDD	ND	0.0500		
1,2,3,7,8,9-HXCDD	ND	0.0500		
1,2,3,4,6,7,8-HPCDD	ND	0.0500		
OCDD	0.090	0.0500		
2,3,7,8-TCDF *	ND	0.0500		
1,2,3,7,8-PECDF	ND	0.0500		
2,3,4,7,8-PECDF	ND	0.0500		
1,2,3,4,7,8-HXCDF	ND	0.0500		
1,2,3,6,7,8-HXCDF	ND	0.0500		
2,3,4,6,7,8-HXCDF	ND	0.0500		
1,2,3,7,8,9-HXCDF	ND	0.0500		
1,2,3,4,6,7,8-HPCDF	0.130	0.0500		
1,2,3,4,7,8,9-HPCDF	ND	0.0500		
OCDF	0.119	0.0500		
TOTAL TETRA-DIOXINS	ND	0.0500		
TOTAL PENTA-DIOXINS	ND	0.0500		
TOTAL HEXA-DIOXINS	ND	0.0500		
TOTAL HEPTA-DIOXINS	ND	0.0500		
TOTAL TETRA-FURANS	ND	0.0500		
TOTAL PENTA-FURANS	ND	0.0500		
TOTAL HEXA-FURANS	ND	0.0500		
TOTAL HEPTA-FURANS	0.130	0.0500		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	0.001
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	0.086

**Surrogate Standards** **% Recovery**

13C-2,3,7,8-TCDD	88.5
13C-1,2,3,7,8-PECDD	94.3
13C-1,2,3,6,7,8-HXCDD	91.3
13C-1,2,3,4,6,7,8-HPCDD	90.2
13C-OCDD	83.0
13C-2,3,7,8-TCDF	86.9
13C-1,2,3,7,8-PECDF	92.2
13C-1,2,3,4,7,8-HXCDF	91.7
13C-1,2,3,4,6,7,8-HPCDF	88.7

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved:

*[Signature]*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	Lab Blank	<b>AXYS FILE:</b>	WG15681-101 :2PT
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	28-Jun-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>PROJECT NO.:</b>	N/A	<b>EXTRACTION DATE:</b>	
<b>SAMPLE TYPE:</b>	SOLID	<b>INSTRUMENT:</b>	HR GC/MS
<b>SAMPLE SIZE:</b>	10.0 g	<b>ANALYSIS DATE:</b>	17-Jun-2005
<b>% Moisture:</b>	0.57	<b>CONCENTRATION IN:</b>	pg/g

COMPOUND	Concentration	(SDL)	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
2,3,7,8-TCDF *	ND	0.0500	2,3,7,8-TCDD TEQs (ND=0) =	0
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	0

**Surrogate Standards**

**% Recovery**

13C-2,3,7,8-TCDF

78.6

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

QA/QC Chemist

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Report Filename: AXYS\_DIOXINS\_AXYSDB225\_WG15681-101\_SJ434623.html; Workgroup: WG15681; Design ID: 194 ]



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** Lab Blank  
**SAMPLE COLLECTION:** N/A  
**CLIENT NO.:** 2607  
**PROJECT NO.:** N/A  
**SAMPLE TYPE:** SOLID  
**SAMPLE SIZE:** 10.0 g  
  
**% Moisture:** 0.30

**AXYS FILE:** WG15727-101 i:2PT  
  
**REPORT DATE:** 08-Jun-2005  
**METHOD NO.:** AXYS METHOD MLA-017 Rev 09  
**EXTRACTION DATE:** 12-May-2005  
**INSTRUMENT:** HR GC/MS  
**ANALYSIS DATE:** 02-Jun-2005  
**CONCENTRATION IN:** pg/g

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	ND	0.0500		
1,2,3,7,8-PECDD	ND	0.0500		
1,2,3,4,7,8-HXCDD	ND	0.0500		
1,2,3,6,7,8-HXCDD	ND	0.0500		
1,2,3,7,8,9-HXCDD	ND	0.0500		
1,2,3,4,6,7,8-HPCDD	0.112	0.0500		
OCDD	0.277	0.0500		
2,3,7,8-TCDF *	ND	0.0500		
1,2,3,7,8-PECDF	ND	0.0500		
2,3,4,7,8-PECDF	ND	0.0500		
1,2,3,4,7,8-HXCDF	ND	0.0500		
1,2,3,6,7,8-HXCDF	ND	0.0500		
2,3,4,6,7,8-HXCDF	ND	0.0500		
1,2,3,7,8,9-HXCDF	ND	0.0500		
1,2,3,4,6,7,8-HPCDF	ND	0.0500		
1,2,3,4,7,8,9-HPCDF	NDR (0.100)	0.0500		
OCDF	NDR (0.100)	0.0500		
TOTAL TETRA-DIOXINS	ND	0.0500		
TOTAL PENTA-DIOXINS	ND	0.0500		
TOTAL HEXA-DIOXINS	ND	0.0500		
TOTAL HEPTA-DIOXINS	0.112	0.0500		
TOTAL TETRA-FURANS	ND	0.0500		
TOTAL PENTA-FURANS	ND	0.0500		
TOTAL HEXA-FURANS	ND	0.0500	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEPTA-FURANS	ND	0.0500	2,3,7,8-TCDD TEQs (ND=0) =	0.001
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	0.085

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	65.3
13C-1,2,3,7,8-PECDD	75.4
13C-1,2,3,6,7,8-HXCDD	77.3
13C-1,2,3,4,6,7,8-HPCDD	71.4
13C-OCDD	65.9
13C-2,3,7,8-TCDF	65.0
13C-1,2,3,7,8-PECDF	70.7
13C-1,2,3,4,7,8-HXCDF	77.0
13C-1,2,3,4,6,7,8-HPCDF	71.0

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*[Signature]*

QA/QC Chemist



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

CLIENT SAMPLE I.D.:	Spiked Matrix	AXYS FILE:	WG15626-102 i
CLIENT NO.:	2607	REPORT DATE:	11-Jun-2005
SAMPLE TYPE:	SOLID	METHOD NO.:	AXYS METHOD MLA-017 Rev 09
SAMPLE SIZE:	10.0 g	INSTRUMENT:	HR GC/MS
		CONCENTRATION IN:	pg/g

COMPOUND	Determined	Expected	% Recovery
2,3,7,8-TCDD	9.87	10.0	98.7
1,2,3,7,8-PECDD	51.6	50.0	103
1,2,3,4,7,8-HXCDD	50.9	50.0	102
1,2,3,6,7,8-HXCDD	51.5	50.0	103
1,2,3,7,8,9-HXCDD	47.7	50.0	95.5
1,2,3,4,6,7,8-HPCDD	51.8	50.0	104
OCDD	101	100	101
2,3,7,8-TCDF	10.3	10.0	103
1,2,3,7,8-PECDF	50.7	50.0	101
2,3,4,7,8-PECDF	50.2	50.0	100
1,2,3,4,7,8-HXCDF	49.6	50.0	99.1
1,2,3,6,7,8-HXCDF	51.5	50.0	103
2,3,4,6,7,8-HXCDF	48.7	50.0	97.4
1,2,3,7,8,9-HXCDF	51.3	50.0	103
1,2,3,4,6,7,8-HPCDF	54.2	50.0	108
1,2,3,4,7,8,9-HPCDF	50.7	50.0	101
OCDF	102	100	102

Surrogate Standards	% Recovery
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13C-2,3,7,8-TCDD	85.9
13C-1,2,3,7,8-PECDD	91.3
13C-1,2,3,6,7,8-HXCDD	95.6
13C-1,2,3,4,6,7,8-HPCDD	84.1
13C-OCDD	80.6
13C-2,3,7,8-TCDF	86.8
13C-1,2,3,7,8-PECDF	89.4
13C-1,2,3,4,7,8-HXCDF	99.8
13C-1,2,3,4,6,7,8-HPCDF	86.5

1. Concentrations are recovery corrected

Approved: \_\_\_\_\_

*B. B. B.*

QA/QC Chemist

For Axy Internal Use Only [ XSL Template: AXYSSpike.xsl; Created: 11-Jun-2005 12:39:45; Application: XMLTransformer-1.4.0;  
Report Filename: AXYS\_DIOXINS\_AXYSD5\_WG15626-102\_SJ414644.html; Workgroup: WG15626; Design ID: 194 ]



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

CLIENT SAMPLE I.D.:	Spiked Matrix	AXYS FILE:	WG15627-102 i
CLIENT NO.:	2607	REPORT DATE:	26-May-2005
SAMPLE TYPE:	SOLID	METHOD NO.:	AXYS METHOD MLA-017 Rev 09
SAMPLE SIZE:	10.0 g	INSTRUMENT:	HR GC/MS
		CONCENTRATION IN:	pg/g

COMPOUND	Determined	Expected	% Recovery
2,3,7,8-TCDD	9.55	10.0	95.5
1,2,3,7,8-PECDD	50.6	50.0	101
1,2,3,4,7,8-HXCDD	49.9	50.0	99.8
1,2,3,6,7,8-HXCDD	51.9	50.0	104
1,2,3,7,8,9-HXCDD	52.5	50.0	105
1,2,3,4,6,7,8-HPCDD	50.2	50.0	100
OCDD	99.8	100	99.8
2,3,7,8-TCDF	10.2	10.0	102
1,2,3,7,8-PECDF	48.7	50.0	97.5
2,3,4,7,8-PECDF	49.3	50.0	98.6
1,2,3,4,7,8-HXCDF	48.9	50.0	97.9
1,2,3,6,7,8-HXCDF	50.8	50.0	102
2,3,4,6,7,8-HXCDF	47.7	50.0	95.3
1,2,3,7,8,9-HXCDF	52.3	50.0	105
1,2,3,4,6,7,8-HPCDF	52.9	50.0	106
1,2,3,4,7,8,9-HPCDF	55.0	50.0	110
OCDF	103	100	103

Surrogate Standards	% Recovery
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13C-2,3,7,8-TCDD	57.9
13C-1,2,3,7,8-PECDD	66.4
13C-1,2,3,6,7,8-HXCDD	63.9
13C-1,2,3,4,6,7,8-HPCDD	68.4
13C-OCDD	62.8
13C-2,3,7,8-TCDF	56.4
13C-1,2,3,7,8-PECDF	63.7
13C-1,2,3,4,7,8-HXCDF	66.4
13C-1,2,3,4,6,7,8-HPCDF	63.3

1. Concentrations are recovery corrected

Approved: \_\_\_\_\_

QA/QC Chemist

For Axyx Internal Use Only [ XSL Template: AXYS\_Spike.xsl; Created: 26-May-2005 17:17:55; Application: XMLTransformer-1.3.0;  
Report Filename: AXYS\_DIOXINS\_AXYSDB5\_WG15627-102\_SJ414569.html; Workgroup: WG15627; Design ID: 194 ]



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

CLIENT SAMPLE I.D.:	Spiked Matrix	AXYS FILE:	WG15628-102
CLIENT NO.:	2607	REPORT DATE:	14-Jun-2005
SAMPLE TYPE:	SOLID	METHOD NO.:	AXYS METHOD MLA-017 Rev 09
SAMPLE SIZE:	10.0 g	INSTRUMENT:	HR GC/MS
		CONCENTRATION IN:	pg/g

COMPOUND	Determined	Expected	% Recovery
2,3,7,8-TCDD	9.82	10.0	98.2
1,2,3,7,8-PECDD	52.4	50.0	105
1,2,3,4,7,8-HXCDD	51.9	50.0	104
1,2,3,6,7,8-HXCDD	52.1	50.0	104
1,2,3,7,8,9-HXCDD	50.2	50.0	100
1,2,3,4,6,7,8-HPCDD	53.1	50.0	106
OCDD	102	100	102
2,3,7,8-TCDF	10.4	10.0	104
1,2,3,7,8-PECDF	50.1	50.0	100
2,3,4,7,8-PECDF	50.6	50.0	101
1,2,3,4,7,8-HXCDF	50.2	50.0	100
1,2,3,6,7,8-HXCDF	52.4	50.0	105
2,3,4,6,7,8-HXCDF	48.0	50.0	95.9
1,2,3,7,8,9-HXCDF	45.6	50.0	91.1
1,2,3,4,6,7,8-HPCDF	56.3	50.0	113
1,2,3,4,7,8,9-HPCDF	53.5	50.0	107
OCDF	101	100	101

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	71.9
13C-1,2,3,7,8-PECDD	76.3
13C-1,2,3,6,7,8-HXCDD	86.3
13C-1,2,3,4,6,7,8-HPCDD	75.3
13C-OCDD	68.3
13C-2,3,7,8-TCDF	67.5
13C-1,2,3,7,8-PECDF	74.2
13C-1,2,3,4,7,8-HXCDF	88.7
13C-1,2,3,4,6,7,8-HPCDF	73.4

1. Concentrations are recovery corrected

Approved: \_\_\_\_\_

*Robert H*

QA/QC Chemist

For Axyx Internal Use Only [ XSL Template: AXYSSpike.xsl; Created: 14-Jun-2005 14:55:08; Application: XMLTransformer-1.4.0;  
Report Filename: AXYX\_DIOXINS\_AXYSD5\_WG15628-102\_SJ416204.html; Workgroup: WG15628; Design ID: 194 ]



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	Spiked Matrix	<b>AXYS FILE:</b>	WG15629-102 i
<b>CLIENT NO.:</b>	2607	<b>REPORT DATE:</b>	07-Jun-2005
<b>SAMPLE TYPE:</b>	SOLID	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE SIZE:</b>	10.0 g	<b>INSTRUMENT:</b>	HR GC/MS
		<b>CONCENTRATION IN:</b>	pg/g

COMPOUND	Determined	Expected	% Recovery
2,3,7,8-TCDD	19.2	20.0	96.2
1,2,3,7,8-PECDD	101	100	101
1,2,3,4,7,8-HXCDD	102	100	102
1,2,3,6,7,8-HXCDD	97.6	100	97.6
1,2,3,7,8,9-HXCDD	101	100	101
1,2,3,4,6,7,8-HPCDD	99.5	100	99.5
OCDD	200	200	100
2,3,7,8-TCDF	20.3	20.0	101
1,2,3,7,8-PECDF	99.5	100	99.5
2,3,4,7,8-PECDF	94.8	100	94.8
1,2,3,4,7,8-HXCDF	99.1	100	99.1
1,2,3,6,7,8-HXCDF	104	100	104
2,3,4,6,7,8-HXCDF	97.9	100	97.9
1,2,3,7,8,9-HXCDF	105	100	105
1,2,3,4,6,7,8-HPCDF	106	100	106
1,2,3,4,7,8,9-HPCDF	101	100	101
OCDF	206	200	103

Surrogate Standards	% Recovery
---------------------	------------

13C-2,3,7,8-TCDD	56.0
13C-1,2,3,7,8-PECDD	57.0
13C-1,2,3,6,7,8-HXCDD	55.4
13C-1,2,3,4,6,7,8-HPCDD	49.3
13C-OCDD	44.3
13C-2,3,7,8-TCDF	54.7
13C-1,2,3,7,8-PECDF	58.3
13C-1,2,3,4,7,8-HXCDF	56.1
13C-1,2,3,4,6,7,8-HPCDF	49.6

1. Concentrations are recovery corrected

Approved: \_\_\_\_\_

QA/QC Chemist

For Axy Internal Use Only [ XSL Template: AXYS\_Spike.xsl; Created: 07-Jun-2005 16:37:19; Application: XMLTransformer-1.4.0;  
Report Filename: AXYS\_DIOXINS\_AXYSDB5\_WG15629-102\_SJ419435.html; Workgroup: WG15629; Design ID: 194 ]



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

CLIENT SAMPLE I.D.:	Spiked Matrix	AXYS FILE:	WG15681-102 :2PT
CLIENT NO.:	2607	REPORT DATE:	28-Jun-2005
SAMPLE TYPE:	SOLID	METHOD NO.:	AXYS METHOD MLA-017 Rev 10
SAMPLE SIZE:	10.0 g	INSTRUMENT:	HR GC/MS
		CONCENTRATION IN:	pg/g

COMPOUND	Determined	Expected	% Recovery
2,3,7,8-TCDD	9.39	10.0	93.9
1,2,3,7,8-PECDD	47.9	50.0	95.8
1,2,3,4,7,8-HXCDD	49.3	50.0	98.5
1,2,3,6,7,8-HXCDD	50.4	50.0	101
1,2,3,7,8,9-HXCDD	49.2	50.0	98.3
1,2,3,4,6,7,8-HPCDD	48.5	50.0	97.0
OCDD	98.0	100	98.0
2,3,7,8-TCDF	9.90	10.0	99.0
1,2,3,7,8-PECDF	47.6	50.0	95.2
2,3,4,7,8-PECDF	45.9	50.0	91.7
1,2,3,4,7,8-HXCDF	46.7	50.0	93.3
1,2,3,6,7,8-HXCDF	49.4	50.0	98.8
2,3,4,6,7,8-HXCDF	47.9	50.0	95.7
1,2,3,7,8,9-HXCDF	52.4	50.0	105
1,2,3,4,6,7,8-HPCDF	51.6	50.0	103
1,2,3,4,7,8,9-HPCDF	48.7	50.0	97.5
OCDF	96.1	100	96.1

Surrogate Standards	% Recovery
---------------------	------------

13C-2,3,7,8-TCDD	78.5
13C-1,2,3,7,8-PECDD	83.7
13C-1,2,3,6,7,8-HXCDD	79.9
13C-1,2,3,4,6,7,8-HPCDD	80.2
13C-OCDD	71.7
13C-2,3,7,8-TCDF	77.1
13C-1,2,3,7,8-PECDF	85.0
13C-1,2,3,4,7,8-HXCDF	79.8
13C-1,2,3,4,6,7,8-HPCDF	79.1

1. Concentrations are recovery corrected

Approved:



QA/QC Chemist

For Axy Internal Use Only [ XSL Template: AXYS\_Spike.xsl; Created: 28-Jun-2005 12:48:01; Application: XMLTransformer-1.4.2;  
Report Filename: AXYS\_DIOXINS\_AXYSDB5\_WG15681-102\_SJ434619.html; Workgroup: WG15681; Design ID: 194 ]





**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	Spiked Matrix	<b>AXYS FILE:</b>	WG15727-102 :2PT
<b>CLIENT NO.:</b>	2607	<b>REPORT DATE:</b>	08-Jun-2005
<b>SAMPLE TYPE:</b>	SOLID	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 09
<b>SAMPLE SIZE:</b>	10.0 g	<b>INSTRUMENT:</b>	HR GC/MS
		<b>CONCENTRATION IN:</b>	pg/g

COMPOUND	Determined	Expected	% Recovery
2,3,7,8-TCDD	9.76	10.0	97.6
1,2,3,7,8-PECDD	52.1	50.0	104
1,2,3,4,7,8-HXCDD	49.4	50.0	98.9
1,2,3,6,7,8-HXCDD	50.6	50.0	101
1,2,3,7,8,9-HXCDD	51.4	50.0	103
1,2,3,4,6,7,8-HPCDD	49.3	50.0	98.7
OCDD	99.1	100	99.1
2,3,7,8-TCDF	10.3	10.0	103
1,2,3,7,8-PECDF	48.9	50.0	97.8
2,3,4,7,8-PECDF	48.2	50.0	96.3
1,2,3,4,7,8-HXCDF	49.5	50.0	99.0
1,2,3,6,7,8-HXCDF	51.8	50.0	104
2,3,4,6,7,8-HXCDF	49.4	50.0	98.8
1,2,3,7,8,9-HXCDF	54.2	50.0	108
1,2,3,4,6,7,8-HPCDF	51.2	50.0	102
1,2,3,4,7,8,9-HPCDF	50.9	50.0	102
OCDF	102	100	102

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	51.8
13C-1,2,3,7,8-PECDD	60.6
13C-1,2,3,6,7,8-HXCDD	56.4
13C-1,2,3,4,6,7,8-HPCDD	53.8
13C-OCDD	50.5
13C-2,3,7,8-TCDF	51.1
13C-1,2,3,7,8-PECDF	55.2
13C-1,2,3,4,7,8-HXCDF	56.6
13C-1,2,3,4,6,7,8-HPCDF	54.2

1. Concentrations are recovery corrected

Approved: \_\_\_\_\_

*Robert H*

QA/QC Chemist

For Axys Internal Use Only [ XSL Template: AXYS\_Spike.xsl; Created: 08-Jun-2005 14:14:24; Application: XMLTransformer-1.4.0;  
Report Filename: AXYS\_DIOXINS\_AXYSDB5\_WG15727-102\_SJ422891.html; Workgroup: WG15727; Design ID: 194 ]



# BATCH SUMMARY

<b>Batch ID:</b> WG17076	<b>Date:</b> 03-Nov-2005
<b>Analysis Type:</b> DIOXINS/FURANS	<b>Matrix Type:</b> SOLID
<b>BATCH MAKEUP</b>	
<b>Contract:</b> 2607 <b>Samples:</b> L8155-9 L8155-10 L8155-11 L8155-12 L8155-13 L8155-28	<b>Blank:</b> WG17076-101
	<b>Reference or Spike:</b> WG17076-102
	<b>Duplicate:</b>
<b>Comments:</b> 1. Data is not blank corrected	

**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	Lab Blank	<b>AXYS FILE:</b>	WG17076-101 :2PT
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	03-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>PROJECT NO.:</b>	N/A	<b>EXTRACTION DATE:</b>	
<b>SAMPLE TYPE:</b>	SOLID	<b>INSTRUMENT:</b>	HR GC/MS
<b>SAMPLE SIZE:</b>	10.0 g	<b>ANALYSIS DATE:</b>	28-Oct-2005
<b>% Moisture:</b>	1.85	<b>CONCENTRATION IN:</b>	pg/g

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	ND	0.0500		
1,2,3,7,8-PECDD	ND	0.0500		
1,2,3,4,7,8-HXCDD	ND	0.0500		
1,2,3,6,7,8-HXCDD	ND	0.0500		
1,2,3,7,8,9-HXCDD	ND	0.0500		
1,2,3,4,6,7,8-HPCDD	0.293	0.0564		
OCDD	2.33	0.0500		
2,3,7,8-TCDF *	ND	0.0500		
1,2,3,7,8-PECDF	ND	0.0500		
2,3,4,7,8-PECDF	0.059	0.0500		
1,2,3,4,7,8-HXCDF	ND	0.0500		
1,2,3,6,7,8-HXCDF	ND	0.0500		
2,3,4,6,7,8-HXCDF	0.059	0.0500		
1,2,3,7,8,9-HXCDF	0.066	0.0500		
1,2,3,4,6,7,8-HPCDF	0.071	0.0500		
1,2,3,4,7,8,9-HPCDF	0.075	0.0500		
OCDF	0.169	0.0500		
TOTAL TETRA-DIOXINS	ND	0.0500		
TOTAL PENTA-DIOXINS	ND	0.0500		
TOTAL HEXA-DIOXINS	ND	0.0500		
TOTAL HEPTA-DIOXINS	0.293	0.0564		
TOTAL TETRA-FURANS	ND	0.0500		
TOTAL PENTA-FURANS	0.059	0.0500	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEXA-FURANS	0.125	0.0500	2,3,7,8-TCDD TEQs (ND=0) =	0.047
TOTAL HEPTA-FURANS	0.146	0.0500	2,3,7,8-TCDD TEQs (ND=1/2 DL) =	0.113

**Surrogate Standards                      % Recovery**

13C-2,3,7,8-TCDD	69.9
13C-1,2,3,7,8-PECDD	81.6
13C-1,2,3,6,7,8-HXCDD	82.4
13C-1,2,3,4,6,7,8-HPCDD	80.6
13C-OCDD	77.6
13C-2,3,7,8-TCDF	65.2
13C-1,2,3,7,8-PECDF	77.4
13C-1,2,3,4,7,8-HXCDF	86.9
13C-1,2,3,4,6,7,8-HPCDF	80.4

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*Robert M*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

CLIENT SAMPLE I.D.:	Spiked Matrix	AXYS FILE:	WG17076-102 :2PT
CLIENT NO.:	2607	REPORT DATE:	03-Nov-2005
SAMPLE TYPE:	SOLID	METHOD NO.:	AXYS METHOD MLA-017 Rev 10
SAMPLE SIZE:	10.0 g	INSTRUMENT:	HR GC/MS
	CONCENTRATION IN:		pg/g

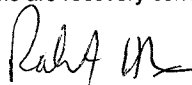
COMPOUND	Determined	Expected	% Recovery
2,3,7,8-TCDD	9.41	10.0	94.1
1,2,3,7,8-PECDD	48.9	50.0	97.8
1,2,3,4,7,8-HXCDD	50.3	50.0	101
1,2,3,6,7,8-HXCDD	50.2	50.0	100
1,2,3,7,8,9-HXCDD	49.7	50.0	99.4
1,2,3,4,6,7,8-HPCDD	49.1	50.0	98.1
OCDD	100	100	100
2,3,7,8-TCDF	9.93	10.0	99.3
1,2,3,7,8-PECDF	47.7	50.0	95.3
2,3,4,7,8-PECDF	49.0	50.0	98.0
1,2,3,4,7,8-HXCDF	47.0	50.0	94.0
1,2,3,6,7,8-HXCDF	49.0	50.0	97.9
2,3,4,6,7,8-HXCDF	48.4	50.0	96.8
1,2,3,7,8,9-HXCDF	51.3	50.0	103
1,2,3,4,6,7,8-HPCDF	50.9	50.0	102
1,2,3,4,7,8,9-HPCDF	47.7	50.0	95.4
OCDF	95.8	100	95.8

Surrogate Standards	% Recovery
---------------------	------------

13C-2,3,7,8-TCDD	60.8
13C-1,2,3,7,8-PECDD	74.3
13C-1,2,3,6,7,8-HXCDD	64.7
13C-1,2,3,4,6,7,8-HPCDD	63.9
13C-OCDD	60.6
13C-2,3,7,8-TCDF	58.2
13C-1,2,3,7,8-PECDF	68.6
13C-1,2,3,4,7,8-HXCDF	64.7
13C-1,2,3,4,6,7,8-HPCDF	63.4

1. Concentrations are recovery corrected

Approved: \_\_\_\_\_



QA/QC Chemist

For Axy Internal Use Only [ XSL Template: AXYS\_Spike.xsl; Created: 03-Nov-2005 14:50:03; Application: XMLTransformer-1.4.23;  
Report Filename: AXYS\_DIOXINS\_AXYSDB5\_WG17076-102\_SJ480861.html; Workgroup: WG17076; Design ID: 194 ]



# BATCH SUMMARY

<b>Batch ID:</b> WG16989		<b>Date:</b> 07-Nov-2005	
<b>Analysis Type:</b> DIOXINS/FURANS		<b>Matrix Type:</b> SOLIDS	
<b>BATCH MAKEUP</b>			
<b>Contract:</b> 2607 <b>Samples:</b>	<b>AXYS ID</b>	<b>Client ID</b>	<b>Blank:</b> WG16989-101
	L8155-31	05VN-105	
	L8155-32	05VN-108	
	L8155-33	05VN-111	
	L8155-34	05VN-123	
			<b>Reference or Spike:</b> WG16989-102
			<b>Duplicate:</b> WG16989-103    05VN-111
<b>Comments:</b> 1. Data are not blank corrected, and field samples should be evaluated in comparison to the lab blank. In the lab blank, the level of OCDD was above method criteria; however, the client samples have concentrations of this analyte hundreds of times higher than that in the lab blank.			

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**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

**CLIENT SAMPLE I.D.:** Lab Blank  
**SAMPLE COLLECTION:** N/A  
**CLIENT NO.:** 2607  
**PROJECT NO.:** N/A  
**SAMPLE TYPE:** SOLID  
**SAMPLE SIZE:** 10.0 g

**AXYS FILE:** WG16989-101 :2PT  
**REPORT DATE:** 01-Nov-2005  
**METHOD NO.:** AXYS METHOD MLA-017 Rev 10  
**EXTRACTION DATE:**  
**INSTRUMENT:** HR GC/MS  
**ANALYSIS DATE:** 15-Oct-2005  
**CONCENTRATION IN:** pg/g

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	ND	0.0500		
1,2,3,7,8-PECDD	ND	0.0500		
1,2,3,4,7,8-HXCDD	ND	0.0500		
1,2,3,6,7,8-HXCDD	ND	0.0500		
1,2,3,7,8,9-HXCDD	ND	0.0500		
1,2,3,4,6,7,8-HPCDD	NDR (0.199)	0.0500		
OCDD	2.95	0.0623		
2,3,7,8-TCDF *	ND	0.0500		
1,2,3,7,8-PECDF	ND	0.0500		
2,3,4,7,8-PECDF	ND	0.0500		
1,2,3,4,7,8-HXCDF	ND	0.0500		
1,2,3,6,7,8-HXCDF	ND	0.0500		
2,3,4,6,7,8-HXCDF	ND	0.0500		
1,2,3,7,8,9-HXCDF	ND	0.0500		
1,2,3,4,6,7,8-HPCDF	NDR (0.064)	0.0500		
1,2,3,4,7,8,9-HPCDF	ND	0.0500		
OCDF	0.114	0.0500		
TOTAL TETRA-DIOXINS	ND	0.0500		
TOTAL PENTA-DIOXINS	ND	0.0500		
TOTAL HEXA-DIOXINS	ND	0.0500		
TOTAL HEPTA-DIOXINS	ND	0.0500		
TOTAL TETRA-FURANS	ND	0.0500		
TOTAL PENTA-FURANS	ND	0.0500		
TOTAL HEXA-FURANS	ND	0.0500		
TOTAL HEPTA-FURANS	0.099	0.0500		
			<b>2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)</b>	
			2,3,7,8-TCDD TEQs (ND=0) =	0.000
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	0.085

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	87.1
13C-1,2,3,7,8-PECDD	92.3
13C-1,2,3,6,7,8-HXCDD	90.0
13C-1,2,3,4,6,7,8-HPCDD	87.3
13C-OCDD	82.8
13C-2,3,7,8-TCDF	85.7
13C-1,2,3,7,8-PECDF	89.7
13C-1,2,3,4,7,8-HXCDF	91.3
13C-1,2,3,4,6,7,8-HPCDF	86.8

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*P. Dwyer*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

CLIENT SAMPLE I.D.:	Spiked Matrix	AXYS FILE:	WG16989-102 :2PT
CLIENT NO.:	2607	REPORT DATE:	01-Nov-2005
SAMPLE TYPE:	SOLID	METHOD NO.:	AXYS METHOD MLA-017 Rev 10
SAMPLE SIZE:	10.0 g	INSTRUMENT:	HR GC/MS
CONCENTRATION IN:		pg/g	

COMPOUND	Determined	Expected	% Recovery
2,3,7,8-TCDD	9.62	10.0	96.2
1,2,3,7,8-PECDD	49.7	50.0	99.4
1,2,3,4,7,8-HXCDD	51.5	50.0	103
1,2,3,6,7,8-HXCDD	52.1	50.0	104
1,2,3,7,8,9-HXCDD	51.9	50.0	104
1,2,3,4,6,7,8-HPCDD	51.2	50.0	102
OCDD	103	100	103
2,3,7,8-TCDF	10.1	10.0	101
1,2,3,7,8-PECDF	49.7	50.0	99.4
2,3,4,7,8-PECDF	49.4	50.0	98.7
1,2,3,4,7,8-HXCDF	49.2	50.0	98.5
1,2,3,6,7,8-HXCDF	52.0	50.0	104
2,3,4,6,7,8-HXCDF	51.3	50.0	103
1,2,3,7,8,9-HXCDF	52.5	50.0	105
1,2,3,4,6,7,8-HPCDF	53.3	50.0	107
1,2,3,4,7,8,9-HPCDF	49.2	50.0	98.5
OCDF	101	100	101

Surrogate Standards	% Recovery
---------------------	------------

13C-2,3,7,8-TCDD	76.1
13C-1,2,3,7,8-PECDD	78.8
13C-1,2,3,6,7,8-HXCDD	71.5
13C-1,2,3,4,6,7,8-HPCDD	68.8
13C-OCDD	66.6
13C-2,3,7,8-TCDF	75.1
13C-1,2,3,7,8-PECDF	72.7
13C-1,2,3,4,7,8-HXCDF	72.9
13C-1,2,3,4,6,7,8-HPCDF	71.6

1. Concentrations are recovery corrected

Approved:

QA/QC Chemist

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Report Filename: AXYS\_DIOXINS\_AXYSDB5\_WG16989-102\_SJ479718.html; Workgroup: WG16989; Design ID: 194 ]



# BATCH SUMMARY

<b>Batch ID:</b> WG16947	<b>Date:</b> 04-Nov-2005
<b>Analysis Type:</b> DIOXINS/FURANS	<b>Matrix Type:</b> SOLIDS
<b>BATCH MAKEUP</b>	
<b>Contract:</b> 2607 <b>Samples:</b> L8155-14 L8155-15 L8155-16 L8155-17 L8155-18 L8155-19 L8155-20 L8155-21 L8155-22 L8155-23 L8155-24 L8155-25 L8155-26 L8155-27 L8155-29 L8155-30	<b>Blank:</b> WG16947-101
	<b>Reference or Spike:</b> WG16947-102
	<b>Duplicate:</b> WG16947-103
<b>Comments:</b> 1. Data is not blank corrected	



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

<b>CLIENT SAMPLE I.D.:</b>	Lab Blank	<b>AXYS FILE:</b>	WG16947-101
<b>SAMPLE COLLECTION:</b>	N/A	<b>REPORT DATE:</b>	04-Nov-2005
<b>CLIENT NO.:</b>	2607	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 10
<b>PROJECT NO.:</b>	N/A	<b>EXTRACTION DATE:</b>	23-Sep-2005
<b>SAMPLE TYPE:</b>	SOLID	<b>INSTRUMENT:</b>	HR GC/MS
<b>SAMPLE SIZE:</b>	10.0 g	<b>ANALYSIS DATE:</b>	08-Oct-2005
<b>% Moisture:</b>	0	<b>CONCENTRATION IN:</b>	pg/g

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	ND	0.0500		
1,2,3,7,8-PECDD	ND	0.0500		
1,2,3,4,7,8-HXCDD	ND	0.0500		
1,2,3,6,7,8-HXCDD	ND	0.0500		
1,2,3,7,8,9-HXCDD	ND	0.0500		
1,2,3,4,6,7,8-HPCDD	NDR (0.106)	0.0524		
OCDD	0.458	0.0773		
2,3,7,8-TCDF *	ND	0.0500		
1,2,3,7,8-PECDF	ND	0.0500		
2,3,4,7,8-PECDF	ND	0.0500		
1,2,3,4,7,8-HXCDF	ND	0.0500		
1,2,3,6,7,8-HXCDF	ND	0.0500		
2,3,4,6,7,8-HXCDF	ND	0.0500		
1,2,3,7,8,9-HXCDF	ND	0.0500		
1,2,3,4,6,7,8-HPCDF	ND	0.0500		
1,2,3,4,7,8,9-HPCDF	ND	0.0500		
OCDF	0.114	0.0500		
TOTAL TETRA-DIOXINS	ND	0.0500		
TOTAL PENTA-DIOXINS	ND	0.0500		
TOTAL HEXA-DIOXINS	ND	0.0500		
TOTAL HEPTA-DIOXINS	ND	0.0524		
TOTAL TETRA-FURANS	ND	0.0500		
TOTAL PENTA-FURANS	ND	0.0500		
TOTAL HEXA-FURANS	ND	0.0500		
TOTAL HEPTA-FURANS	ND	0.0500		
			2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
			2,3,7,8-TCDD TEQs (ND=0) =	0.000
			2,3,7,8-TCDD TEQs (ND=1/2 DL) =	0.085

Surrogate Standards	% Recovery
13C-2,3,7,8-TCDD	77.4
13C-1,2,3,7,8-PECDD	94.5
13C-1,2,3,6,7,8-HXCDD	90.6
13C-1,2,3,4,6,7,8-HPCDD	94.3
13C-OCDD	89.7
13C-2,3,7,8-TCDF	82.0
13C-1,2,3,7,8-PECDF	86.5
13C-1,2,3,4,7,8-HXCDF	89.6
13C-1,2,3,4,6,7,8-HPCDF	93.8

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*[Signature]*

QA/QC Chemist



**ANALYSIS REPORT  
POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2219, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 655-5800 FAX (250) 655-5811

CLIENT SAMPLE I.D.:	Spiked Matrix	AXYS FILE:	WG16947-102
CLIENT NO.:	2607	REPORT DATE:	04-Nov-2005
SAMPLE TYPE:	SOLID	METHOD NO.:	AXYS METHOD MLA-017 Rev 10
SAMPLE SIZE:	10.0 g	INSTRUMENT:	HR GC/MS
		CONCENTRATION IN:	pg/g

COMPOUND	Determined	Expected	% Recovery
2,3,7,8-TCDD	9.63	10.0	96.3
1,2,3,7,8-PECDD	49.3	50.0	98.6
1,2,3,4,7,8-HXCDD	51.5	50.0	103
1,2,3,6,7,8-HXCDD	48.7	50.0	97.4
1,2,3,7,8,9-HXCDD	52.0	50.0	104
1,2,3,4,6,7,8-HPCDD	49.4	50.0	98.8
OCDD	99.6	100	99.6
2,3,7,8-TCDF	10.1	10.0	101
1,2,3,7,8-PECDF	48.7	50.0	97.4
2,3,4,7,8-PECDF	48.8	50.0	97.6
1,2,3,4,7,8-HXCDF	48.5	50.0	96.9
1,2,3,6,7,8-HXCDF	51.1	50.0	102
2,3,4,6,7,8-HXCDF	50.4	50.0	101
1,2,3,7,8,9-HXCDF	55.6	50.0	111
1,2,3,4,6,7,8-HPCDF	52.8	50.0	106
1,2,3,4,7,8,9-HPCDF	51.0	50.0	102
OCDF	101	100	101

Surrogate Standards	% Recovery
---------------------	------------

13C-2,3,7,8-TCDD	56.5
13C-1,2,3,7,8-PECDD	69.0
13C-1,2,3,6,7,8-HXCDD	63.6
13C-1,2,3,4,6,7,8-HPCDD	67.5
13C-OCDD	64.0
13C-2,3,7,8-TCDF	57.9
13C-1,2,3,7,8-PECDF	64.5
13C-1,2,3,4,7,8-HXCDF	63.0
13C-1,2,3,4,6,7,8-HPCDF	64.8

1. Concentrations are recovery corrected

Approved: \_\_\_\_\_

*Paul H*

QA/QC Chemist

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Report Filename: AXYS\_DIOXINS\_AXYSDB5\_WG16947-102\_SJ473530.html; Workgroup: WG16947; Design ID: 194 ]



# BATCH SUMMARY

<b>Batch ID:</b> DXWG17490	<b>Date:</b> 21-Nov-2005						
<b>Analysis Type:</b> Dioxin/Furan	<b>Matrix Type:</b> Sediment						
<b>BATCH MAKEUP</b>							
<b>Contract:</b> 2607 <b>Samples:</b> <table border="1"> <thead> <tr> <th>AXYS ID</th> <th>Client ID</th> </tr> </thead> <tbody> <tr> <td>L8155-1</td> <td>05VN-001</td> </tr> <tr> <td>L8155-8</td> <td>05VN-026</td> </tr> </tbody> </table>	AXYS ID	Client ID	L8155-1	05VN-001	L8155-8	05VN-026	<b>Blank:</b>  <div style="text-align: center;">WG17490-101</div>
AXYS ID	Client ID						
L8155-1	05VN-001						
L8155-8	05VN-026						
	<b>Reference or Spike:</b>  <div style="text-align: center;">WG17490-102</div>						
<b>Comments:</b>  <ol style="list-style-type: none"> <li>1. Data are not blank corrected, and field samples should be evaluated in comparison to the lab blank. In the lab blank, the level of OCDD was above method criteria. However, the client samples reported from this workgroup have concentrations of this analyte several hundred times higher than those in the lab blank.</li> <li>2. Data for these samples is reported from a repeat analysis, as indicated by the R and R2 suffix on the AXYS ID on the data reports.</li> </ol>							

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**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2218, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 855-5800 FAX (250) 855-5811

**CLIENT SAMPLE I.D.:** Lab Blank  
**SAMPLE COLLECTION:** N/A  
**CLIENT NO.:** 2607  
**PROJECT NO.:** N/A  
**SAMPLE TYPE:** SOLID  
**SAMPLE SIZE:** 10.0 g

**AXYS FILE:** WG17490-101 :2PT  
**REPORT DATE:** 21-Nov-2005  
**METHOD NO.:** AXYS METHOD MLA-017 Rev 11  
**EXTRACTION DATE:**  
**INSTRUMENT:** HR GC/MS  
**ANALYSIS DATE:** 20-Nov-2005  
**CONCENTRATION IN:** pg/g

COMPOUND	Concentration	(SDL)		
2,3,7,8-TCDD	ND	0.0500		
1,2,3,7,8-PECDD	ND	0.0500		
1,2,3,4,7,8-HXCDD	ND	0.0500		
1,2,3,6,7,8-HXCDD	ND	0.0500		
1,2,3,7,8,9-HXCDD	ND	0.0500		
1,2,3,4,6,7,8-HPCDD	NDR (0.187)	0.0500		
OCDD	2.00	0.0500		
2,3,7,8-TCDF *	ND	0.0500		
1,2,3,7,8-PECDF	ND	0.0500		
2,3,4,7,8-PECDF	ND	0.0500		
1,2,3,4,7,8-HXCDF	ND	0.0500		
1,2,3,6,7,8-HXCDF	ND	0.0500		
2,3,4,6,7,8-HXCDF	ND	0.0500		
1,2,3,7,8,9-HXCDF	ND	0.0500		
1,2,3,4,6,7,8-HPCDF	ND	0.0500		
1,2,3,4,7,8,9-HPCDF	ND	0.0500		
OCDF	0.132	0.0500		
TOTAL TETRA-DIOXINS	ND	0.0500		
TOTAL PENTA-DIOXINS	ND	0.0500		
TOTAL HEXA-DIOXINS	ND	0.0500		
TOTAL HEPTA-DIOXINS	ND	0.0500		
TOTAL TETRA-FURANS	ND	0.0500		
TOTAL PENTA-FURANS	ND	0.0500	2,3,7,8-TCDD TEQs (Using WHO 1998 TEFs)	
TOTAL HEXA-FURANS	ND	0.0500	2,3,7,8-TCDD TEQs (ND=0) =	0.000
TOTAL HEPTA-FURANS	ND	0.0500	2,3,7,8-TCDD TEQs (ND=1/2 DL) =	0.085

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	76.4
13C-1,2,3,7,8-PECDD	84.5
13C-1,2,3,6,7,8-HXCDD	81.1
13C-1,2,3,4,6,7,8-HPCDD	83.7
13C-OCDD	76.0
13C-2,3,7,8-TCDF	74.2
13C-1,2,3,7,8-PECDF	81.2
13C-1,2,3,4,7,8-HXCDF	83.3
13C-1,2,3,4,6,7,8-HPCDF	85.9

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration
4. Concentrations are recovery corrected
5. \* = Concentration confirmed by analysis with DB-225 column

Approved: \_\_\_\_\_

*P. Handberg*

QA/QC Chemist

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Report Filename: AXYS\_DIOXINS\_AXYSDB5\_WG17490-101\_SJ489546.html; Workgroup: WG17490; Design ID: 194 ]



**ANALYSIS REPORT**  
**POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS**

**AXYS ANALYTICAL SERVICES**

P.O. Box 2218, 2045 MILLS RD. WEST, SIDNEY, B.C., CANADA  
V8L 3S8 TEL (250) 855-5800 FAX (250) 855-5811

<b>CLIENT SAMPLE I.D.:</b>	Spiked Matrix	<b>AXYS FILE:</b>	WG17490-102 :2PT
<b>CLIENT NO.:</b>	2607	<b>REPORT DATE:</b>	21-Nov-2005
<b>SAMPLE TYPE:</b>	SOLID	<b>METHOD NO.:</b>	AXYS METHOD MLA-017 Rev 11
<b>SAMPLE SIZE:</b>	10.0 g	<b>INSTRUMENT:</b>	HR GC/MS
		<b>CONCENTRATION IN:</b>	pg/g

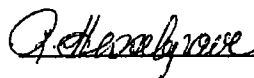
COMPOUND	Determined	Expected	% Recovery
2,3,7,8-TCDD	8.57	10.0	85.7
1,2,3,7,8-PECDD	44.4	50.0	88.9
1,2,3,4,7,8-HXCDD	44.2	50.0	88.5
1,2,3,6,7,8-HXCDD	46.6	50.0	93.2
1,2,3,7,8,9-HXCDD	44.7	50.0	89.4
1,2,3,4,6,7,8-HPCDD	45.0	50.0	90.0
OCDD	89.3	100	89.3
2,3,7,8-TCDF	8.97	10.0	89.7
1,2,3,7,8-PECDF	43.4	50.0	86.8
2,3,4,7,8-PECDF	43.7	50.0	87.3
1,2,3,4,7,8-HXCDF	43.9	50.0	87.7
1,2,3,6,7,8-HXCDF	44.8	50.0	89.6
2,3,4,6,7,8-HXCDF	44.6	50.0	89.1
1,2,3,7,8,9-HXCDF	46.8	50.0	93.7
1,2,3,4,6,7,8-HPCDF	46.4	50.0	92.7
1,2,3,4,7,8,9-HPCDF	43.4	50.0	86.9
OCDF	90.6	100	90.6

**Surrogate Standards**                      **% Recovery**

13C-2,3,7,8-TCDD	79.7
13C-1,2,3,7,8-PECDD	86.9
13C-1,2,3,6,7,8-HXCDD	82.6
13C-1,2,3,4,6,7,8-HPCDD	82.3
13C-OCDD	78.1
13C-2,3,7,8-TCDF	75.9
13C-1,2,3,7,8-PECDF	85.2
13C-1,2,3,4,7,8-HXCDF	83.3
13C-1,2,3,4,6,7,8-HPCDF	84.4

1. Concentrations are recovery corrected

Approved:



QA/QC Chemist

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