APPENDIX W – HISTORICAL TOPOGRAPHY REVIEW

FINAL REMEDIAL INVESTIGATION REPORT
CASMALIA RESOURCES SUPERFUND SITE
CASMALIA, CALIFORNIA

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LIST OF ACRONYMS

CNS	Casmalia Neutralization System
CSC	Casmalia Steering Committee
EPA	Environmental Protection Agency
NGVD	National Geodetic Vertical Datum
NTU	Nephelometric Turbidity Unit
P/S	pesticides/solvents
PCB	polychlorinated biphenyl
PSCT	Perimeter Source Control Trench
QA/QC	Quality Assurance/Quality Control
RCF	Runoff Containment Facility
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
TIN	triangulated irregular network
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WCCB	West Canyon Catch Basin

1.0 INTRODUCTION

This appendix contains the CSC's evaluation of topographic changes at the site during the period 1959 to 1998. The nature of topographic changes at the site is relevant to planning investigations and analysis for the RI/FS. The review included two components, including (1) a qualitative review of topographic changes as observed from topographic maps for the period 1959 to 1993; and (2) a quantitative comparison of topographic changes experienced between 1987 and 1998. This latter evaluation included digitizing the 1987 topography and electronically comparing it to the 1998 digital file available for the entire site. The CSC also prepared an oblique view of the site illustrating cut and fill across the site and that information is presented on Figure 2-53 of the RI/FS Work Plan.

In addition to a general description of changes to site topography through time, this appendix contains a cut/fill topographic map and several cross sections through the former ponds illustrating site conditions following completion of former pond closure activities conducted during 1988 and 1989. Because some of the ponds were backfilled after closure excavations were made, the CSC reviewed the available data to document that closure samples were obtained from those ponds and prepared cross sections with the closure samples plotted on them to illustrate an approximate base grade for the pond excavations. For the ponds where 1998 topography was lower than the 1987 grades, the 1998 topography reasonably depicts the approximate base grades following closure because the only minor grading (limited to erosion repairs) was completed between the pond closure period and 1998.

After 1998, the CSC made significant cuts and fills within the landfill limits while capping the landfills (see the "Existing Cap Limits" on the figures) and thus, the cut and fill analysis on this appendix does not reflect current conditions within the cap limits. The cut that the CSC made in the Ponds A and B area in 2002 (referred to as the "South Borrow Area"), is however reflected in the analysis presented in this appendix.

2.0 PURPOSE AND OBJECTIVES

The CSC conducted the historical topographic review in order to help scope and focus the remedial investigation planned as part of the RI/FS. The CSC wanted to demonstrate the nature of historical topographic changes at the site and the depth and breadth of the site excavations for a number of reasons, including supporting a random sampling approach for the former pond and pads areas located south of the PSCT proposed in the Draft Work Plan submitted to EPA on June 3, 2001. Note that the CSC proposes focused sampling in the former ponds and pads north of the PSCT that were previously recommended for closure as landfills. Although the CSC catalogued the lab reports and synthesized the elevations of pond closure samples as part of this appendix, the CSC does not plan to use the actual chemical data collected from the pond closure period. The Agencies have expressed concerns regarding the quality of the data and the CSC could not likely collect the necessary laboratory QA/QC reports to perform a data quality review.

The CSC is proposing sampling for all of the ponds and pads located south of the PSCT, although the pond liquids, sludges and subgrade soils were removed to the then accepted target clean up levels during ponds closure (see Section 2.8.1 of the Work Plan). The culverts connecting the ponds also were removed and piping subgrade soils were sampled; the berms between most ponds also were removed during pond closure. Finally, in an attempt to prepare this area for a planned landfill expansion, Casmalia Resources graded the remaining soils in this area and effectively spread the subgrade soils away from the original footprints of the ponds and pads. Based on the cut/fill comparison presented in this appendix it appears that Casmalia Resources cut approximately 2.8 million cubic yards of material during the pond closure process.

3.0 HISTORICAL TOPOGRAPHIC MAP REVIEW

This section presents a review of historical topography at the Casmalia Resources Superfund Site (Site) for the period between 1959 and 1993. This period was selected because it encompasses the time from pre-site development conditions, through site operation and into the post operation period. The historical topography review consisted of a qualitative review of readily apparent topographic changes between 1959 and 1993 within the following conceptual study areas defined in the RI/FS Work Plan (refer to Figure 3-24):

- Capped Landfills;
- PCB Landfill;
- RCRA Canyon Area;
- West Canyon Spray Area;
- Burial Trench Area;
- Central Drainage Area;
- Liquids Treatment Area;
- Maintenance Shed Area;
- Administration Building Area;
- Roadways; and
- Remaining On-site Area.

The historical topography review consisted of a visual review of the following seven topographic maps:

Year	Flight Date	Scale	Contour Interval	Source
1959*	--	1:24,000	40 ft.	U.S. Geological Survey Casmalia 7.5' Quadrangle
1974	1974 (date unspecified)	1:4,800	5 ft.	Mark Hurd Research, Santa Barbara, CA
1979	June 1979	1:2,400	5 ft. and 10 ft.	Penfield & Smith, Santa Barbara, CA
1982	June 2, 1982	1:2,400	5 ft. and 10 ft.	Penfield & Smith, Santa Barbara, CA
1985	June 26, 1985	1:2,400	2 ft. and 10ft.	Western Pacific Aerial Surveys, Santa Barbara, CA.
1987	April 6, 1987	1:2,400	2 ft. and 10 ft.	Western Pacific Aerial Surveys, Santa Barbara, CA.
1993	June 18, 1993	1:1,200	2 ft. and 10 ft.	USEPA

* Note: For 1959 map, 40' contour interval combined with lack of readily apparent site features makes accurate determination of elevation ranges in various conceptual study areas impractical.

Scanned images of each of these maps are included in a Compact Disk, included as Attachment 1 to this appendix.

The limits of the above-listed conceptual study areas were overlain on each of these seven topographic maps in order to facilitate the historical topographic review. The review was then conducted, proceeding in order from the oldest map (1959) to the latest map (1993).

The qualitative review of each site area on each topographic map focused on evaluating changes in the following items for each site area:

- Minimum elevation;
- Maximum elevation;
- Topographic trend/surface gradient; and
- Apparent topographic changes within each site area relative to the preceding (e.g., 1974 versus 1959) topographic map.

Readily apparent topographic changes noted during this review are detailed for each map in Table W-1, and summarized below.

3.1 Capped Landfills

Minimum elevations within the Capped Landfill Area ranged from an apparent low of 500' in 1974 to a high of approximately 510' in 1993 where the principal historical drainage exiting this area crosses into the Central Drainage Area. Maximum elevations ranged from an apparent low of 730' to 735' in 1979-1987, to a high of 750' in 1974 near the northwest corner of the area. For all years reviewed except 1993, the entire Capped Landfills area appeared to drain in a southerly direction into the Central Drainage Area. The 1993 topography indicates that the surface gradient for the westerly slopes of the P/S landfill trend to the southwest and no longer drained to the Central Drainage Area. Maps dated 1959, 1974, and 1979 indicate surface grades in the Capped Landfills Area to reflect natural topographic conditions. As of 1979, Pond R was shown to be present outside the southwestern border of this area. As of 1982, the topography in the western portion of this area had been substantially increased in height relative to conditions in 1979. As of 1985, the topography was again substantially altered, including the presence of multiple graded pads and readily apparent landfill areas. As of 1987, elevations in the Solvents/Pesticides Landfill appear to be about 40 feet higher than in 1985, and grades in the Caustics, Metals, and Acids landfills had also been raised relative to 1985 conditions. Map notations in the west-central portion of the Pesticides/Solvents Landfill are shown to indicate an east-west trending waste disposal trench designated as "Trench 7." As of 1993, the topography in the Capped Landfill Area had again been substantially altered compared to 1987, with surface elevations increased throughout a large portion of the area (up to 75 feet), and all of the previously recognized graded pads are no longer apparent.

3.2 PCB Landfill

Minimum elevations within the PCB Landfill area remain relatively unchanged during the period reviewed, ranging from approximately 676–680 feet along the southern border. Maximum elevations apparently remained consistent at 785 feet at the northwest corner on eastern side of Pond 19. The slope of the PCB Landfill area trended to the south for all years reviewed. Maps dated 1959, 1974, and 1979 indicate surface grades in the PCB Landfill Area to reflect natural topographic conditions. Topography depicted in the 1982 map indicates that grades in this area had been altered substantially compared to conditions in 1979, the area apparently having been graded into two gently sloping benches in the northern and southern halves. A northeast-southwest trending linear trench is apparent in the 1982 map that separates the two graded benches. This trench has been locally excavated to depths of up to 25 feet below the grades of the flanking graded benches. Topographic changes noted in subsequent years indicate more subtle modifications to the south-facing surface grades in this area, with more gradual and gentler slope being developed through time across the lowered area previously noted in the 1979 map.

3.3 RCRA Canyon Area

The minimum elevation within the RCRA Canyon Area was approximately 460–475 feet at the southeast corner over all years examined. Maximum elevations ranged from an apparent low of 750 feet in 1985-1993 to 760 feet in 1974-1982 at the northern tip of the area. The slope of the RCRA Canyon Area trended to the south-southwest for all years reviewed. Modifications to the topography in this area were noted on the 1985 map within the northeast portion, in the southern half, and along the western side. The topography in the northeast portion was modified by the apparent creation of a flat area at an elevation of approximately 707 feet. The topography in the southern half was modified by the creation of several flat areas and the topography along the western side was modified by flattening and benching of the slopes. Two areas in the north and central portions of the canyon bottom appear to have been widened and leveled compared to the 1982 map. Annotations in the canyon bottom presented on the 1985 map indicate “RCRA Solid Waste Landfill.” The topography on the 1987 topographic map is largely similar to the 1982 map, but a catch basin (Pond 43 or WCCB) is present along the southeastern margin of the area, and an area at the base of slope in the head of the canyon is designated as “Waste Burial Area.” The topography on the 1993 map is similar to the 1987 map, however, the catch basin is no longer evident and the topography along the western edge appears to be sloped more steeply to the east than in 1987.

3.4 West Canyon Spray Area

Minimum elevations at the West Canyon Spray Area ranged from approximately 470-475 feet on the western border of this area for all year periods reviewed. The maximum elevation at this area for the years reviewed was consistently 710 feet at the northeast corner. For all the years reviewed, except 1993, the surface gradient of the West Canyon Spray Area trended to the west-southwest. In 1993, the area trended in a more southerly direction. The topography of this area appears to have been first modified by flattening and benching in the northeast corner between 1979 and 1982. As of 1985, the topography of this area had been substantially modified throughout. A large, flat graded area and two closed depressions are depicted on the 1985 map, lying directly west of the Liquid Treatment Area, and Pad 18 had been added in the southern portion as of 1985. The 1987 topography of this area is largely similar to 1985, with the exception of the northeastern corner, where slopes had apparently been steepened by local excavation. As of 1993, the topography of this area had been significantly modified relative to 1987. The surface gradient in 1993 was toward the south (versus previous west-southwest), displaying a more uniform slope through the central and southern portions. By 1993, Pad 18 is no longer evident in the southern portion of this area.

3.5 Burial Trench Area

Minimum elevations within the Burial Trench Area ranged from approximately 600-610 feet along the southern border for the years reviewed. Maximum elevations ranged from approximately 690-700 feet at the northwest corner. For all years reviewed, the slope of the Burial Trench Area generally trends to the south. The topography of the Burial Trench Area was first modified between 1959 and 1974, and appears to have been increased in elevation by about 25 feet (note: the 1959 map has a 40-foot contour interval while the 1974 map has a 5-foot contour interval, thereby making accurate comparisons difficult). The topography in 1979 appears generally similar to 1974, with the notable exception of two closed depressions along the northern border and northeast quadrant. The topography in 1982 has been modified in

comparison to 1979. Additionally, the two approximately 11-15 foot deep depressions noted in the northern portion of the area in 1979 are no longer evident on the 1982 topographic map. The topography in 1985 is similar to 1982, but Pond 23 has been developed across the center of the area (surface elevation of approximately 644 feet). The topography in 1987 is similar to 1985, but modifications are evident in the southern and western portions of the area where the grade had been leveled and lowered somewhat compared to 1985. In addition, numerous waste disposal trenches and wells are labeled on the 1987 map. The 1993 map indicates that the topography was modified relative to 1987, including the absence of the pond-like feature in the center of the area and steepening of slops in the southern portion. Waste disposal trenches and wells are no longer depicted in this area on the 1993 map.

3.6 Central Drainage Area

Minimum elevations within the Central Drainage Area ranged from a low of 448 feet in 1993 to a high of 475 feet in 1985 and 1987 where a drainage exits the southern border. Maximum elevations ranged from a low of 622 feet in 1982 to a high of 650 feet in 1985 and 1987 at the northernmost border. For all years reviewed, the slope of the Central Drainage Area generally trends towards the center and then to the south. The topography of the Central Drainage Area was modified between 1974 and 1979, and included the creation of flat pond areas (Ponds R, 7, and 6) near the western and southern borders of the area. The topography was modified substantially between 1979 and 1982, including disappearance of the distinct drainage features that previously traversed the center of the area, and the addition of 5 to 6, flat pond like features that now encompass over 50 percent of the area. Surface elevations of the flat areas in 1982 ranged from 469 feet near the southwest border to approximately 519 feet near the western border of the area. The topography was modified again between 1982 and 1985, including terrain modifications in the areas of new Pond 22, Pad 10A, and Pond R. Other apparent modifications include the additions of Pad 9A, Pad 9B, Pond 6, and Pond 19 – the listed elevations at these latter features are generally the same in 1985 as in 1982, indicating that grading of these new pond/pad areas had apparently been completed by 1982. The topography in 1987 appeared essentially the same as it did in 1985. Review of the 1993 map indicates that the topography of the Central Drainage Area was modified substantially between 1987 and 1993. As of 1993, no evidence of former pond and pad features was present, and a north/south surface drainage feature had again been established in the center of the area.

3.7 Liquids Treatment Area

Minimum elevations within the Liquids Treatment Area ranged from 558-570 feet along the southern border. Maximum elevations ranged from 600-610 feet at the northern tip of this area. For all years reviewed, the slope of the Liquids Treatment Area generally trended to the south and southwest. The topography of the Liquids Treatment Area was apparently modified between 1959 and 1974, as evidenced by the higher elevations in this area in 1974. The topography of this area was again modified between 1974 and 1979 in the central portion, including the addition of a flat, pond feature (Pond 15) (surface elevation of 579 feet). The topography of this area was modified substantially between 1979 and 1982, including the apparent flattening of the central portion of this area (average elevation of central area approximately 580 feet in 1982) and the apparent disappearance of Pond 15. The overall topography on the 1985 map was essentially the same as the 1982 map, although the central portion appears to have been graded flat for the W.A.O. Unit and adjoining tanks. The topography in the northern half was modified again between 1985 and 1987, and apparently

leveled to allow development of additional waste treatment facilities (CNS). Review of the 1993 map indicates that the topography in this area was again modified between 1987 and 1993 in the northeast quadrant, where the grade was apparently leveled and merged with adjoining areas to the east.

3.8 Maintenance Shed Area

Minimum elevations in the Maintenance Shed Area remained consistent at approximately 570 feet at the southern border for all years reviewed. Maximum elevations also remained consistent at approximately 600 feet along the northern border. For all years reviewed, the slope of the Maintenance Shed Area trended to the south-southeast. Review of the 1979 map indicates that the topography of this area was leveled between 1974 and 1979 to facilitate construction of the shop. The 1982 map indicates that the topography south of the shop was flattened again since 1979. The topography depicted in 1985, 1987 and 1993 maps of this area appears similar to that for 1982.

3.9 Administration Building Area

Minimum elevations at the Administration Building Area ranged from a low of 443 feet (water level pond 12) in 1979 to a high of 455 feet in 1993 at the western border. Maximum elevations ranged from a low of 450 feet in 1974 to a high of 470 feet in 1985 and 1987 at the northern border. The Administration Building Area is relatively flat, with the surface gradient trending gently to the west (1959-1987), and gently to the west and south as of 1993. The topographic modifications at the Administration Building Area in the years reviewed appear to be principally related to the area of Pond 12 to the west. Pond 12 was apparently constructed between 1974 and 1979 and was no longer evident as of 1993.

3.10 Roadways

Evolution of the roadway system at the site generally paralleled the location and nature of site development through time, with new roads being added and/or modified as various portions of the site were prepared, developed and operated. With the exception of NTU road and a single north-south trending ”jeep trail” traversing the central portion of the site, the 1959 map illustrates what appears to be natural, undisturbed topography throughout the site area. The 1959 map depicts NTU road in the same general alignment as is currently recognized. Topographic maps from 1974 through 1987 depict the progressive development of roadways systems throughout the various areas of the site. Roadways were developed to provide access to the various portions of the site as additional facilities were developed, including operational facilities (maintenance building, administration buildings, liquid treatment area) and waste management units (ponds, pads and landfill areas). Initial site roadway development is first noted on the 1974 map, and is concentrated primarily in the western portion of the Remaining Onsite Area, south of the Liquid Treatment Area, apparently in association with development of the initial ponds in this area. No roadways are noted on the 1974 map in the Capped Landfills Area, Central Drainage Area, Liquid Treatment Area, RCRA Canyon Area, or West Canyon Spray Area. Major expansion of the site roadway system is noted principally on the 1979, 1982 and 1985 maps. During this time, roads were developed along the northern, eastern and western site perimeters, and an extensive system of roads was developed to provide access to the numerous ponds, pads, landfill and operational facilities that were also developed during this period. Roadways depicted on the 1987 map were largely similar to those illustrated on the 1985 map. Notable

changes indicated on the 1987 map included modification to roadways around individual landfill areas, expansion of roads into the West Canyon Spray Area, and development of a road into the RCRA Canyon Area from the south. Major changes to the roadway system were again noted on the 1993 map, where the majority of roads once surrounding the various ponds and pads throughout the site were apparently removed during pond closure activities that had been conducted since 1987. Remnants of several former principal roadways are still apparent in some site areas on the 1993 map. Notable road remnants include one traversing north-northeasterly across the Remaining Onsite Area south of the Maintenance Shed Area, several extending north-northwest across the western portion of the Central Drainage Area, and one descending from the Central Drainage Area toward the north shore of the RCF. The 1993 map also depicts numerous new roads that had been developed across the site since 1987, including roads within the Capped Landfills Area, the completely regraded Central Drainage Area, the area north and west of the Administration Building Area, portions of the West Canyon Spray Area, and the northerly upslope areas of the RCRA Canyon Area.

3.11 Remaining On-site Area

The minimum elevation within the Remaining On-site Area ranged from a low of approximately 375 feet in Pond 13 (water level) at the southern tip in 1993 to a high of 400 feet in 1974 in roughly the same location. The maximum elevation in this area remained consistent at approximately 835 feet at the extreme northerly tip of the site for all years reviewed. The overall surface gradient for the Remaining On-site Area is to the south. The topography of this area was modified between 1959 and 1974 as evidenced, in part, by the presence of 6-7 apparent large ponds to the south of the Liquids Treatment Area. As of 1974, the surface elevations in the flat pond areas ranged from 475 feet in the south, to about 550-570 feet in the north. The topography was substantially modified between 1974 and 1979 with the addition of multiple ponds throughout the central and southern portions of this area. Between 1979 and 1982, approximately 6 ponds were developed across a drainage that had previously exited the southwest corner of the site. In addition, several ponds were added north-northwest of the Administration Building Area; the topography was significantly modified in and around all areas where these new ponds were installed. Multiple ponds and pads are identified on the 1985 map, although the majority of these features appear to have been already graded as of 1982. Examples of new grading/facilities apparently developed between 1982 and 1985 include Pad 1A and Pond A-6 in the southwest portion, Pond 15 on the east side of the West Canyon Spray Area, and the addition of the “Sludges 2” area adjacent to the eastern facility boundary. A designated “Truck Storage Area” is indicated on the 1985 map in a flat, graded area originally depicted in the 1982 map, lying just outside the southwestern boundary of the facility. Topography within this area is largely similar between the 1985 and 1987 maps. As of 1993, topography throughout this area had been substantially modified relative to 1987. The majority of former pond and pad features are no longer evident in the area, and the pond features in the southwestern and south-central portions appear to either be merged into one the currently existing surface runoff control ponds (RCF, A-Series Pond and Pond 13), or are no longer present. In addition, Pad 1A is no longer evident, whereas previous Ponds A-5 and Pond 18 are still evident in their original positions. Topography depicted in the 1993 topographic map indicates that this area had been completely graded to direct storm water runoff into the existing surface water control ponds.

4.0 ANALYSIS OF TOPOGRAPHIC CHANGES DURING POND CLOSURE ACTIVITIES

To support a random sampling strategy, the CSC completed the following additional tasks during the topographic review activities:

- Depict the 1987 and 1998 topography including bottom of pond topography which is not otherwise shown on site topographic maps;
- Create and cut/fill topographic map (showing grade line of cut and fill) and an oblique view showing gradation of cut and fill;
- Prepare cross sections through the major pond and pad areas of the site and plot closure sample locations on the cross section of ponds that show "fill" on the cut/fill maps to illustrate closure base grades for those ponds;
- Catalog the laboratory sheet numbers for the closure and verifications samples collected in each pond and pad; and
- Quantify the cut and fill volume made during the pond closure period.

The primary information used in the evaluation included site-wide topographic maps depicting ground surface conditions in 1987 and 1998. The source information for these topographic base maps is presented below.

Year	Flight Date	Scale	Source
1987	April 6, 1987	1:2,400	Western Pacific Aerial Surveys, Santa Barbara CA
1998	July 8, 1998	1:2,400	Pacific Engineering Associates, Inc. Santa Maria, CA

The 1998 topographic map was readily available for use in digital form; however the 1987 map was not. The CSC digitized a hard copy of the 1987 map, thereby generating an electronic format drawing that could be used in the topographic evaluation.

Both topographic maps have a contour interval of 2 feet. After conversations with the engineering and surveying firms, which created them, it was determined that the topographic contours presented in each map have an accuracy of 2 feet in both the horizontal and vertical direction. "Hard" points, such as the corners of fixed structures, have an accuracy of approximately 0.1 foot, and points such as spot elevations on the ground surface have an accuracy of approximately 0.2 feet. The electronic elevation surfaces used in the comparison were derived from the contours on the respective maps, which were themselves derived from the system of control points and the grid system initially established by the surveyors. An additional small error was possible in the digitized map (digitization error may occur due to incomplete flattening of small folds and distortions in the hard copy if done on a digitizing board or scanner—errors in this case were small because there were continuous rectangular grid points marked across the map, enabling close registration of the digitizing device). There was no projection error, since both maps were created in the same coordinate system (California State Plane Zone 5, NAD 27, Feet). Overall, there is a possible cumulative elevation error of four feet; however, in practice the error is much smaller. To test these accuracy determinations, five control points were draped on relatively flat areas close to but outside of the site boundary – in selected locations where the topography was unlikely to have changed between 1987 and 1998 – and the difference in elevation between the surfaces was calculated. The maximum difference was 1.47 feet, with an average error of 1.08 feet.

Because the original maps did not include bottom topography of the historical waste management ponds nor the existing storm water management and treated liquids storage ponds, the CSC augmented the 1987 and 1998 maps to include pond-bottom topography. Bottom topography for the historical waste management ponds was derived from pre-closure elevations and profiles for each former impoundment as illustrated in two intersecting, orthogonal cross sections presented in the Existing Surface Impoundment Closure and Post-Closure Plan (Canonie Environmental, 1989; Appendix A – Pond Cross Sections). To complete the bathymetry of the former impoundment pond bottoms, each of these cross sections were digitized and then used to extrapolate pond bottom contours. The extrapolated pond bottom bathymetry was then embedded into the 1987 site topographic map (Figure W-1). All 3-dimensional work was done in AutoCAD using the QuickSurf plug-in. The principal contouring assumption was that the pond side-slopes depicted in the cross sections was consistent between section locations in each former pond. Since the software used was not able to interpolate contours in this way – it could not follow the pond outline between points of intersection with a section line – the contours were mostly drawn manually. Pond bottoms were contoured by connecting points of equal elevation on the respective cross sections, using a contour, which followed the shape of the pond shoreline. Bottom topography for the existing storm water and treated liquids storage ponds were derived from pond-bottom soundings measured in October 1999 (Pond 18 only) and June 2002 (all others). For the existing storm water and treated liquids storage ponds, for which direct measurement bottom soundings were available, the same contouring assumption was made, and the pond bottoms were contoured accordingly. Electronic surfaces derived from the contours were made with derivatives turned off, and with all interpolation based on a TIN (triangulated irregular network), thereby avoiding gridding artifacts such as slope overshoots.

Accuracy in elevation of the interpolated pond bottom surfaces is necessarily lower than that of the topographic maps. The source cross sections were generated based on pond soundings and pond construction details (Canonie, 1989; Appendix A), but the precise data used to generate them was not presented. Elevation error in some of the deeper ponds could be up to 10 feet in some places, especially if pond side slopes differ from the assumptions used.

The completed topographic maps used in the evaluation are included in this appendix as Figures W-1 (1987) and W-2 (1998).

A correction factor was then applied in order to account for the difference in National Geodetic Vertical Datum (NGVD) used in creating the original topographic maps. A correction factor of +2.69 feet, equal to the difference between the 1929 NGVD used for the 1987 map, and the 1988 NGVD used for the 1998 map, was applied to the surface derived from the 1987 topographic map in order to bring the vertical datum into uniformity to allow direct comparison. The surfaces derived from the two completed topographic maps were then compared electronically to generate a “results surface” which showed the net topographic change that had taken place across the site between 1987 and 1998.

Information from this electronic comparison was used to create two new images that graphically illustrate the net change in Site topography between these dates, including a “cut-fill map” of the site (Figure W-3) and an oblique view image (Work Plan Section 2.8.1, Figure 2-53). The cut-fill map and the oblique view image are different graphical representations of the same information. These images illustrate and quantify the magnitude of topographic change, either positive (i.e., fill) or negative (i.e., cut), that has occurred at any location on the site between the dates of the 1987 and 1998 aerial photographs used in creating the original topographic maps. Additional

earthwork was conducted in a limited portion of the site during 2002 ("South Borrow Area") to obtain borrow material for the landfill capping and buttress construction projects. The limits of the South Borrow Area, and the effect of ground surface modifications resulting from these recent grading activities, are reflected in the oblique view image (Work Plan Section 2.8.1, Figure 2-53) and the cut-fill map (Figure W-3).

Using the results of the topographic comparison, the CSC constructed a series of 31 cross-sections across the site. The positions of these comparative topographic cross-sections are illustrated in Figure W-4, and the cross-sections themselves are presented in Figures W-5 through W-13. These cross-sections graphically compare site ground surface elevations as of 1987, 1998 and, in some cases 2002, with respect to the former positions of ponds and pads. Cross-sections were constructed through the majority of former ponds at the site, including all former pond areas which were backfilled during pond closure (i.e., ponds where the 1998 land surface is higher than the 1987 surface). Based upon the topographic evaluation findings, portions of the following former pond/pad areas are noted to have been backfilled: Ponds 1, 5, 6, 12, 14, 19, 20, 22, 23, P, R, and WCCB, Sludges I and Pad 1A.

The positions of soil samples collected and analyzed as part of surface impoundment closure activities during 1988 and 1989 to confirm pond closure conditions ("closure confirmation samples") are illustrated on the 1987 topographic map (Figure W-1) and on all cross-sections that pass through former pond areas that are now backfilled. Basal closure confirmation samples for each of these former ponds were used to estimate the approximate closure surface for each of these former ponds. This surface is indicated on the appropriate cross-sections. In all cases this estimated closure surface lies below the pre-closure 1987 pond bottoms, serving to document that soils were removed from these pond areas during closure activities. Closure confirmation samples shown on the cross-sections to lie above the estimated closure surface were typically sidewall samples collected above the base of the closure excavation. Note that pond closure samples are shown on the cross sections for only ponds and pads that were backfilled during the pond closure period. The 1998 grades reasonably represent the pond base grades for the other ponds and pads.

Tables W-2A and W-2B present a listing of all former ponds and pads and associated analytical laboratory report numbers for closure samples collected during the impoundment closure program at the site. These tables generally summarize the level of effort and laboratory data documentation available for two levels of closure sample documentation, including closure confirmation samples, and closure verification samples. Closure confirmation samples (Table W-2A) were collected and analyzed in accordance with the methods outlined in the Existing Surface Impoundment Closure and Post-Closure Plan (Canonie, 1987), whereas closure verification samples (Table W-2B) were collected at the direction of Central Coast California Regional Water Control Board staff during final walk-through inspections of each former impoundment by this agency.

The cut and fill estimates (provided in bank, or in place, cubic yards) using the information presented in this appendix are as follows:

Comparison Years	Cut (Cubic Yards)	Fill (Cubic Yards)	Delta (Cubic Yards)
1987 to 1998	2,818,182	2,642,145	176,038

The delta (or difference between the cut and fill) may reflect the net volume change that was effected when the material was compacted in place. Any other computational errors are well within reason.