

## 7.0 ANALYTICAL PROCEDURES

**7.0.0.1.** The specific analytical methods included in this QAPP are listed in Table 7-1 and briefly described in Tables 7-2 and 7-3. The methods are from the following sources:

- EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third edition, September 1986a; Final Update I, July 1992; Final Update IIA, August 1993; Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996).
- EPA 100-400 Series - Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600R-93/100, August 1993a)
- EPA 200 Series - Methods for the Determination of Metals in Environmental Samples, (EPA/600/4-91-010, June 1991; Supplement I, EPA/600/R-94/111, May 1994a)
- EPA 600 Series - Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater (U.S. EPA, CFR Title 40, Part 136, Appendix A, July 1996)
- Compendium of Methods for Determination of Toxic Organic Compounds in Ambient Air (EPA/600/4-89/017, June 1988b)
- State of California, Department of Health Services, Determination of Perchlorate by Ion Chromatography (Rev. No. 0, June 1997)

**7.0.0.2.** These methods were included in the QAPP because they are standard methods of analysis, are the most commonly used methods of analysis for both organic or inorganic

parameters, meet detection limit criteria for risk assessment, and meet National Pollution Discharge Elimination Standards (NPDES) requirements. All samples shall be prepared and analyzed in accordance with the methods listed in Table 7-1 and in accordance with the Contract Laboratory's Standard Operating Procedures (SOPs). The analytical methods, holding times, and units of measure are listed in Table 4-1.

## **7.1 METHOD DETECTION LIMITS, PRACTICAL QUANTITATION LIMITS, AND CONTRACT REQUIRED QUANTITATION LIMITS**

**7.1.0.1.** The following paragraphs present Hill AFB's definition of method detection, practical quantitation, and contract required detection limits and how analytical data shall be reported. The practical quantitation limits (PQLs) for each analyte are listed by method in Appendices A through H. Method detection limits (MDLs) are not included in this QAPP because they are laboratory specific. Method detection limits and PQLs for all target analytes shall be included in the project-specific work plans.

**7.1.0.2. Method Detection Limits.** The MDL is an empirically-derived value that is used to estimate the lowest concentration a method can detect in a matrix-free environment. The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. MDLs shall be updated annually by the Contract Laboratory following the guidance in 40 CFR 136 Appendix A. The project-specific MDLs shall be included in the project-specific work plans.

**7.1.0.3. Practical Quantitation Limits.** The PQL is the lowest concentration that can be reliably achieved within limits of precision and accuracy during routine operating conditions and is based on the MDL for each analyte. The PQLs for most analytical methods included in this QAPP are presented in Appendices A through H. MDLs and PQLs are laboratory specific. If the Contract Laboratory's PQLs vary from those listed in

this QAPP, they shall be defined in the project-specific work plan. For most projects the PQLs shall be the CRQLs.

**7.1.0.4. Reporting Requirements.** All soil data shall be reported on a dry weight basis. Non-detections in method blanks shall be reported as less than the MDL or PQL (<MDL or <PQL). Whether the MDL or PQL is used is method-specific (refer to Appendices A through H). For all other samples the following will apply:

- All target analyte non-detections shall be reported (at a minimum) as less than the PQL. VOC and SVOC target analyte detections between the MDL and PQL shall be reported and flagged with a “T” to indicate an estimated concentration below the PQL.
- If target analytes are detected at or above the PQL, they shall be reported as quantified.
- Except for VOCs and SVOCs, detections shall not be reported below the PQL due to the limited accuracy and precision associated with quantification.

**7.1.0.5. Additional Reporting Requirements for Definitive Data.** If a sample must be diluted and reanalyzed to bring the concentration of a single compound of interest within the linear calibration range of the instrument, and this results in non-detection of other originally detected target analytes, the data for both the initial and reanalysis shall be reported with the appropriate notations in the case narrative. If samples must be diluted and reanalyzed due to matrix interference, a detailed description of all failures to meet the project-specific PQLs shall be included in the case narrative and the supporting documentation (chromatograms or data reports) shall be included in the definitive data packages.

TABLE 7-1

## ANALYTICAL METHODS INCLUDED IN THE BASEWIDE QAPP

Method <sup>(a)</sup>	Description	Instrumentation
<b>Aqueous and Solid Sample Organic Methods of Analysis</b>		
SW-846 8015B	Non-Halogenated Organics by Gas Chromatography; Gas Range and Diesel Range	Gas Chromatography
SW-846 8021B	Purgable Halogenated and Aromatic Volatile Organic Compounds	Gas Chromatography
EPA 601	Purgable Halocarbons (Aqueous samples only)	Gas Chromatography
EPA 602	Purgable Aromatic Hydrocarbons (Aqueous samples only)	Gas Chromatography
SW-846 8260B	Volatile Organic Compounds by Gas Chromatography/Mass Spectroscopy	Gas Chromatography/Mass Spectrometry
EPA 624	Purgable Aromatic Hydrocarbons and Halocarbons (Aqueous analysis only)	Gas Chromatography/Mass Spectrometry
SW-846 8270C	Semi-Volatile Organic Compounds by Gas Chromatography/Mass Spectroscopy	Gas Chromatography/Mass Spectrometry
EPA 625	Base, Neutral, and Acid Extractable Compounds (Aqueous samples only)	Gas Chromatography/Mass Spectrometry
SW-846 8151A	Organochlorine Herbicides and Pentachlorophenol	Gas Chromatography
SW-846 8081A	Chlorinated Pesticides (updated version of SW-846 8080)	Gas Chromatography
EPA 608	Chlorinated Insecticides and Polychlorinated Biphenyls (Aqueous samples only)	Gas Chromatography
SW-846 8082	Polychlorinated biphenyls	Gas Chromatography
SW-846 8310	Polynuclear Aromatic Hydrocarbons	High Performance Liquid Chromatography
SW-846 8330	Explosives	High Performance Liquid Chromatography
SW-846 8280A	Dioxins and Furans High Resolution Gas Chromatography and Low Resolution	Gas Chromatography/Mass Spectrometry
SW-846 8290	Dioxins and Furans High Resolution Gas Chromatography and High Resolution	Gas Chromatography/Mass Spectrometry
<b>Aqueous and Solid Sample Metals Methods of Analysis</b>		
SW-846 7000 Series	Metals Graphite Furnace Atomic Absorption	Atomic Adsorption
EPA 200.9	Metals Graphite Furnace Atomic Absorption	Atomic Adsorption
SW-846 6010A/B	All Metals Inductively Coupled Plasma (except mercury)	Inductively Coupled Plasma
EPA 200.7	All Metals Inductively Coupled Plasma (except mercury)	Inductively Coupled Plasma
SW-846 6010A Trace	All Metals (except mercury) Inductively Coupled Plasma: usually used only for those metals whose	Inductively Coupled Plasma Trace
SW-846 6020	All Metals (except mercury) Inductively Coupled Plasma: usually used only for those metals whose	Inductively Coupled Plasma/Mass
SW-846 7470A/7471A	Mercury cold-vapor atomic absorption	Atomic absorption; cold-vapor generator
EPA 245.1/245.5		
EPA 200.8	All Metals (except mercury) Inductively Coupled Plasma: usually used only for those metals whose detection limits from standard ICP exceed project-specific requirements (i.e., arsenic, lead, selenium)	Inductively Coupled Plasma/Mass Spectroscopy

**TABLE 7-1**  
**ANALYTICAL METHODS INCLUDED IN THE BASEWIDE QAPP**  
**(CONTINUED)**

<b>Method<sup>(a)</sup></b>	<b>Description</b>	<b>Instrumentation</b>
<b>Aqueous Sample Anions and Water Quality Parameters Methods of Analysis</b>		
SW-846 7196A	Hexavalent-Chromium	Colorimetric
EPA 300.0	Chloride, Fluoride, Sulfate, Nitrate/Nitrite	Ion Chromatography
EPA 300.0 MOD	Pechlorate	Ion Chromatography
EPA 340.2	Fluoride	Ion Selective Electrode
EPA 353.2	Nitrate/Nitrite	Colorimetric
EPA 376.2	Sulfide	Colorimetric
EPA 310.1	Alkalinity	Titrimetric
EPA 160.1	Total Dissolved Solids	Gravimetric
EPA 160.2	Total Suspended Solids	Gravimetric
SW-846 9060	Total Organic Carbon	Combustion/Oxidation
EPA 415.1/.2	Total Organic Carbon	Combustion/Oxidation
<b>Air Sample Analysis</b>		
TO-3, TO-14	Ethane and Methane	Gas Chromatography
TO-13	Polynuclear Aromatic Hydrocarbons (Semi-Volatile Organic Compounds)	Gas Chromatography/Mass Spectrometry
TO-14	Volatile Organic Compounds	Gas Chromatography/Mass Spectrometry
<b>Field Screen Analysis</b>		
SW-846 6200	Proposed determination of Elemental Concentrations in Soil and Sediment Field Portable X-ray Fluorescence Spectrometer	X-ray Fluorescence Spectroscopy
SW-846 4020	Screening for Polychlorinated Biphenyls	Immunoassay
SW-846 4030	TNT Explosives in Soil	Immunoassay
SW-846 4051	Hexahydro-1, 3, 5 Trinitro-1, 3, 5 Triazine (ROX) in Soil	Immunoassay
SW-846 8515	Colorimetric Screening Method for Trinitroluene (TNT) in soil	Colorimetric

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, September 1986; Final Update I, July 1992; Final Update IIA, August 1993; Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996).  
EPA 100-400 Series - Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600R-93/100, August 1993).  
EPA 200 Series - Methods for the Determination of Metals in Environmental Samples (EPA/600/4-91-010, June 1991; Supplement I, EPA/600/R-94/111, May 1994).  
EPA 600 Series - Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater (U.S. EPA, CFR Title 40, Part 136, Appendix A, July 1996).  
Compendium of Methods for Determination of Toxic Organic Compounds in Ambient Air (EPA/600/4-89/017, June 1988).  
State of California Department of Health Services Determination of Perchlorate by Ion Chromatography (Rev. No. 0, June 1997).

TABLE 7-2

## SUMMARY OF EXTRACTION PROCEDURES

Method <sup>(a)</sup>	Matrix	Extraction Procedure
SW-846 8260B, EPA 624 VOCs by GC/MS SW-846 8021B, EPA 601, EPA 602, SW-846 8015B VOCs by GC	Water	SW-846 5030 Purge and Trap: an inert gas is bubbled through a portion of aqueous sample, and the volatile components are transferred from the aqueous phase to the vapor phase. After purging is complete, the components are introduced into a gas chromatograph.
	Soil	SW-846 5021 Headspace: an aliquot of soil is placed into a headspace vial at sampling. A matrix modifying solution, internal standards, and surrogates are added. Vials are rotated and maintained at room temperature. One hour prior to analysis, the sample vials are heated and mixed by mechanical vibration. The vials are pressurized by helium, which forces the headspace gas mixture onto the gas chromatograph.
	Soil	SW-846 5035 Purge and Trap and Extraction Soil and Waste: An aliquot of soil is placed in a preweighed vial containing 10 ml of methanol. Add surrogate. An aliquot of methanol is added to 5 ml of reagent water in a purge tube. Internal standards are added to the solution. An inert gas is bubbled through the solution, and the volatile components are transferred from the solution (aqueous phase) to the vapor phase. After purging is complete, the components are introduced into a gas chromatograph.
SW-846 8270C, EPA 625 SVOCs by GC/MS SW-846 8081A, 8082, 8151A EPA 608, SW-846 8015B SVOCs by GC SW-846 8310 Polynuclear Aromatic Hydrocarbons by HPLC	Water	SW-846 3510 Separatory Funnel Liquid-Liquid Extraction: 1 liter of sample is added to a 2-liter separatory funnel and sequentially extracted with methylene chloride. The final extract is concentrated to volume using a Kuderna-Danish (K-D) apparatus and nitrogen evaporation.
	Water	SW-846 3520 Continuous Liquid-Liquid Extraction: 1 liter of sample is placed into a continuous liquid-liquid extractor and extracted with methylene chloride for 18 hours (per fraction). The final extract is concentrated to volume using a Kuderna-Danish (K-D) apparatus and nitrogen evaporation.
	Soil	SW-846 3550 Ultrasonic Extraction: an aliquot of soil is added to anhydrous ammonium sulfate and extracted with methylene chloride using ultrasonic extraction. The extract is separated from the sample by centrifugation and concentrated to volume using nitrogen evaporation.

**TABLE 7-2**  
**SUMMARY OF EXTRACTION PROCEDURES**  
**(CONTINUED)**

<b>Method<sup>(a)</sup></b>	<b>Matrix</b>	<b>Extraction Procedure</b>
SW-846 8330, Explosives by HPLC	Water	Aqueous samples of low concentration are extracted by a salting-out extraction procedure with acetonitrile and sodium chloride. Aqueous samples of higher concentration can be diluted 1:1 with methanol or acetonitrile and filtered.
	Soil	Soil and sediment samples are extracted using acetonitrile in an ultrasonic bath and filtered.
SW-846 8280A, 8290 Dioxins/Furans	Water	Separatory Funnel Liquid-Liquid Extraction: 1 liter of sample is added to a 2-liter separatory funnel and sequentially extracted with methylene chloride.  Continuous Liquid-Liquid Extraction: 1 liter of sample is placed into a continuous liquid-liquid extractor and extracted with methylene chloride for 18 hours.
	Solid	Samples are extracted with the combination of a Dean-Stark water trap and a Soxhlet extractor using toluene.
TO-3 VOCs in Air	Air	Samples are collected into SUMMA canisters or Tedlar bags. The Summa canister must first be pressurized with nitrogen for introduction into the analytical system. Tedlar bags may be attached directly to the analytical system unless a dilution is required.
TO-13 SVOCs in Air	Air	Approximately 325 square meters of ambient air is drawn through a filter and adsorbent cartridge using a calibrated sampler. The filters and adsorbent cartridges are extracted by Soxhlet extraction with appropriate solvent, concentrated by Kuderna-Danish (K-D) evaporator, followed by silica gel clean-up and further concentration to final volume.
TO-14 VOCs in Air	Air	A sample of air is collected into a SUMMA canister and attached to the analytical system at the laboratory.
SW-846 6010A/B, EPA 200.7 ICP Metals	Water	SW-846 3005: prepares water samples for total recoverable and dissolved metals determination by ICP or ICP-MS. The filtered or unfiltered sample is heated with dilute hydrochloric and nitric acids prior to metals determination.
SW-846 6020, EPA 200.8 ICP-MS Metals		SW-846 3015: prepares aqueous samples and wastes that contain suspended solids for total metals determination by GFAA, ICP, and ICP-MS. Nitric acid is added to the sample which is heated in a microwave unit prior to metals determination.

**TABLE 7-2**  
**SUMMARY OF EXTRACTION PROCEDURES**  
**(CONTINUED)**

Method <sup>(a)</sup>	Matrix	Extraction Procedure
SW-846 6010A/B, EPA 200.7 ICP Metals	Soil	SW-846 3050: prepares waste samples (soils, sludges, and solids) for total metals determination by ICP or ICP-MS. Samples are vigorously digested in nitric acid and hydrogen peroxide followed by dilution with either nitric or hydrochloric acid.
SW-846 6020, EPA 200.8 ICP-MS Metals		SW-846 3051: prepares sludges, sediments, soils, and oils for total metals determination by GFAA, ICP, and ICP-MS. Nitric acid is added to the sample which is heated in a microwave unit prior to metals determination.
SW-846 7000 Series, EPA 200.9 GFAA Metals	Water	SW-846 3015: prepares aqueous samples and wastes that contain suspended solids for total metals determination by GFAA, ICP, and ICP-MS. Nitric acid is added to the sample which is heated in a microwave unit prior to metals determination  SW-846 3020: prepares waste samples for total metals determination by GFAA or ICP-MS. The samples are vigorously digested with nitric acid followed by dilution with nitric acid.
	Soil	SW-846 3051: prepares sludges, sediments, soils, and oils for total metals determination by GFAA, ICP, and ICP-MS. Nitric acid is added to the sample which is heated in a microwave unit prior to metals determination.
SW-846 7470A, EPA 245.1	Water	SW-846 7470A: prepares aqueous samples and wastes for mercury determination by cold-vapor AA. Sulfuric acid, nitric acid, and potassium permanganate are added to the sample which is shaken. Then potassium persulfate is added and sample is heated in a water bath. Sample is cooled and sodium chloride – hydroxylamine is added, stannous sulfate is added and the sample is aerated prior to analysis.
SW-846 7471A, EPA 245.5	Soil	SW-846 7471A: prepares soil, sediment, and sludge for mercury determination by cold-vapor AA. Untreated sample is placed in a BOD bottle containing reagent water and aqua region. The sample is heated then cooled and reagent water and potassium permanganate is added to the sample. The sample is heated, then cooled and the excess potassium permanganate is reduced with sodium chloride-hydroxylamine sulfate. Or, the sample is oxidized using concentrated sulfuric and nitric acid. Potassium permanganate is added to the sample and the sample is autoclaved and allowed to cool. Reagent water and sodium chloride-hydroxylamine are added to the solution to reduce the excess permanganate.
SW-846 7196A Hexavalent Chromium	Water	None
SW-846 7196A Hexavalent Chromium	Soil	SW-846 3060A: This method uses alkaline digestion and heat to solubilize both water-insoluble and water soluble chromium (VI) compounds in solid waste samples.

**TABLE 7-2**  
**SUMMARY OF EXTRACTION PROCEDURES**  
**(CONTINUED)**

Method <sup>(a)</sup>	Matrix	Extraction Procedure
EPA 160.1 Total Dissolved Solids	Water	A well-mixed sample is filtered through a standard glass fiber filter.
EPA 160.2 Total Suspended Solids	Water	A well-mixed sample is filtered through a standard glass fiber filter.
EPA 300.0 Anions: Chloride, fluoride, sulfate, nitrite, nitrate	Water	None required.
EPA 300.0 MOD Perchlorate	Water	None required.
EPA 310.1 Alkalinity	Water	None. Sample must not be altered in any way.
EPA 340.2 Fluoride	Water	None required.
EPA 353.2 Nitrite/Nitrate	Water	Samples must be filtered.
EPA 376.2 Sulfide	Water	None required.
SW-846 9060, EPA 415.1/415.2 Total Organic Carbon	Water	The sample is first homogenized in a blender, the pH is adjusted to 2 and the sample is purged with nitrogen for 10 minutes.

- (a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, September 1986; Final Update I, July 1992; Final Update IIA, August 1993; Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996).  
EPA 100-400 Series - Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600R-93/100, August 1993).  
EPA 200 Series - Methods for the Determination of Metals in Environmental Samples (EPA/600/4-91-010, June 1991; Supplement I, EPA/600/R-94/111, May 1994).  
EPA 600 Series - Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater (U.S. EPA, CFR Title 40, Part 136, Appendix A, July 1996).  
Compendium of Methods for Determination of Toxic Organic Compounds in Ambient Air (EPA/600/4-89/017, June 1988).  
State of California Department of Health Services Determination of Perchlorate by Ion Chromatography (Rev. No. 0, June 1997).

VOCs Volatile Organic Compounds

GC/MS Gas Chromatography/Mass Spectroscopy

HPLC High Performance Liquid Chromatography

GFAA Graphite Furnace Atomic Adsorption

AA Atomic Adsorption

SVOCs Semi-Volatile Organic Compounds

GC Gas Chromatography

ICP/MS Inductively Coupled Plasma/Mass Spectrometry

ICP Inductively Coupled Plasma

TABLE 7-3

## SUMMARY OF ANALYTICAL PROCEDURES

Method <sup>(a)</sup>	Analytical Procedure
SW-846 8260B, EPA 624 VOCs by GC/MS	Volatile compounds are introduced onto a 30-meter capillary column in a gas chromatograph (GC), temperature programmed to separate the analytes, which are then detected with a mass spectrometer (MS) interfaced with the GC. Quantitation is accomplished by comparing response of a major (quantitation ) ion relative to an internal standard using a 5-point calibration curve.
SW-846 8021B, EPA 601, EPA 602 SW-846 8015B VOCs by GC	Volatile compounds are introduced onto a 30-meter capillary column in a gas chromatograph (GC), temperature programmed to separate the analytes, which are then detected by a photoionization detector (PID) and/or an electrolytic conductivity detector (ELCD) or a flame ionization detector (FID). Concentrations are calculated by comparing the response of a compound to a 5-point calibration curve.
SW-846 8270C, EPA 625 SVOCs by GC/MS	Semi-volatile compounds are introduced onto a 30-meter capillary column in a gas chromatograph (GC), temperature programmed to separate the analytes, which are then detected with a mass spectrometer (MS) interfaced with the GC. Quantitation is accomplished by comparing response of a major (quantitation ) ion relative to an internal standard using a 5-point calibration curve.
SW846 8081A, 8082, 8151A, EPA 608 SW-846 8015B SVOCs by GC	Semi-volatile compounds are introduced onto a 30-meter capillary column in a gas chromatograph (GC), temperature programmed to separate the analytes, which are then detected by an electron capture detector (ECD) or a flame ionization detector (FID). Concentrations are calculated by comparing the response of a compound to a 5-point calibration curve.
SW-846 8310 Polynuclear Aromatic Hydrocarbons by HPLC	Method 8310 provides high performance liquid chromatographic (HPLC) conditions for the detection of ppb levels of certain polynuclear aromatic hydrocarbons. An aliquot of the extract is injected into an HPLC and compounds in the effluent are detected by ultraviolet (UV) and fluorescent detectors.
SW-846 8330 Explosives by HPLC	Method 8330 provides HPLC conditions for the detection of ppb levels of certain explosives residues in waters and soils an aliquot of extract is separated on a C-18 reverse phase column, determined at 254 nm, and confirmed on a CN reverse phase column.
SW-846 8280A Dioxins/Furans	An aliquot of the concentrated extract is injected into a HRGC/LRMS (high resolution gas chromatograph/low resolution mass spectrometer) capable of performing SIM (selected ion monitoring). Identification of target compounds is based on elution order and comparison to standard solutions from an appropriate GC column and MS identification. A calculation of toxicity equivalent concentration (TEQ) of each sample is made using international consensus toxicity equivalence factors (TEFs).

**TABLE 7-3**  
**SUMMARY OF ANALYTICAL PROCEDURES**  
**(CONTINUED)**

Method <sup>(a)</sup>	Analytical Procedure
SW-846 8290 Dioxins/Furans	An aliquot of the concentrated extract is injected into a HRGC/HRMS (high resolution gas chromatograph/high resolution mass spectrometer) capable of performing SIM (selected ion monitoring). Identification of target compounds is based on elution order and comparison to standard solutions from an appropriate GC column and MS identification. Quantitation is performed using a multi-point calibration curve for each homologue.
TO-3 VOCs in Air	Samples are introduced by a sample loop onto a 30-meter capillary column in a gas chromatograph (GC), temperature programmed to separate the analytes, which are then detected by a photoionization detector (PID) and a flame ionization detector (FID) connected in a series. Concentrations are calculated by comparing the response of a compound to a 5-point calibration curve.
TO-13 SVOCs in Air	Sample is introduced into a gas chromatograph (GC) which is equipped with either a flame ionization detector (FID), mass spectrometer (MS), or high performance liquid chromatograph (HPLC). Sample concentrations are calculated using a 5-point calibration curve.
TO-14 VOCs in Air	The volatile compounds are concentrated by collection on a cryogenically-cooled trap, then revolatilized and introduced onto a gas chromatograph (GC) coupled to one or more detectors. These detectors may include a flame ionization detector (FID), photoionization detector (PID), and mass spectrometer (MS), among others. Sample concentrations are calculated using a 5-point calibration curve.
SW-846 6010A/B, EPA 200.7 ICP Metals	The inductively coupled plasma method measures element-emitted light by optical spectrometry. Samples are nebulized and the resulting aerosol is transported to the plasma torch. Element-specific atomic-line emission spectra are produced by a radio-frequency inductively coupled plasma. The spectra are dispersed by a grating spectrometer and the intensities of the emission lines are monitored by photo sensitive devices.
SW-846 6020, EPA 200.8 ICP/MS Metals	The inductively coupled plasma- mass spectrometry (ICP-MS) method measures ions produced by a radio-frequency inductively coupled plasma. Samples are nebulized and the resulting aerosol is transported to the plasma torch. The ions produced are introduced into a mass spectrometer where they are sorted according to their mass-to-charge ratios and quantified with a channel electron multiplier.

**TABLE 7-3**  
**SUMMARY OF ANALYTICAL PROCEDURES**  
**(CONTINUED)**

Method <sup>(a)</sup>	Analytical Procedure
SW-846 7000 Series, EPA 200.9 GFAA Metals	For the graphite furnace technique in conjunction with an atomic absorption spectrophotometer (GFAA), a sample aliquot is placed in the graphite tube in the furnace, evaporated to dryness, charred and atomized. The metal atoms to be measured are placed in the beam of radiation by increasing the temperature of the furnace, causing volatilization. The wavelength of the light beam is characteristic of only the metal being determined, and the light energy being absorbed is a measure of the concentration of that metal in the sample.
SW-846 7470A/7471A, EPA 245.1/245.5 Cold Vapor AA	Mercury is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an atomic adsorption spectrophotometer. Absorbency (253.7 nm) is measured as a function of mercury concentration.
SW-846 7196a Hexavalent-Chromium	Dissolved hexavalent chromium in the absence of interference from substances such as molybdenum, vanadium, and mercury maybe determined colorometrically by reaction with diphenylcarbizide in acid solution.
EPA 160.1 Total Dissolved Solids	The filtrate is evaporated and dried to constant weight at 180 degrees Centigrade.
EPA 160.2 Total Suspended Solids	The filtrate is evaporated and dried to constant weight at 103-105° degrees centigrade.
EPA 300.0 Anions: Chloride, fluoride, sulfate, nitrite, nitrate	A small volume of sample, usually 2-5 ml is introduced into an ion-chromatograph. The anions of interest are separated and measured, using a system comprised of a guard column, separator column, suppressor device and conductivity detector. Concentrations are calculated by comparing the response of the target analyte to the calibration curve based on either peak height or peak area.
EPA 300.0 MOD Perchlorate	A small volume of sample, usually 2-5 ml is introduced into an ion-chromatograph. The anions of interest are separated and measured, using a system comprised of a guard column, separator column, suppressor device and conductivity detector.
EPA 310.1 Alkalinity	An unaltered sample is titrated to an electrometrically determined end point of pH 4.5.
EPA 340.2 Fluoride	Fluoride is determined potentiometrically using a fluoride electrode in conjunction with a reference electrode and a pH meter.
EPA 353.2 Nitrite/Nitrate	The sample is passed through a column containing granulated copper-cadmium to reduce nitrate to nitrite, which is measured colorometrically.

**TABLE 7-3**  
**SUMMARY OF ANALYTICAL PROCEDURES**  
**(CONTINUED)**

Method <sup>(a)</sup>	Analytical Procedure
EPA 376.2 Sulfide	Sulfide reacts with p-aminodimethyl aniline in the presence of ferric chloride to produce methylene blue, which is measured at a wavelength maximum of 625 nanometers.
SW-846 9060, EPA 415.1/415.2 Total Organic Carbon	Organic carbon is measured using a carbonaceous analyzer, which converts the organic carbon in a sample to carbon dioxide by either catalytic combustion or wet chemical oxidation. The carbon dioxide formed is then either measured directly by an infrared detector or converted to methane and measured by a flame ionization detector.

- (a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, September 1986; Final Update I, July 1992; Final Update IIA, August 1993; Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996).  
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 State of California Department of Health Services Determination of Perchlorate by Ion Chromatography (Rev. No. 0, June 1997).

VOCs	Volatile Organic Compounds	C-18	Octadecyl
SVOCs	Semi-Volatile Organic Compounds	CN	Cyanopropyl
GFAA	Graphite Furnace Atomic Adsorption	nm	Nanometer