UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

OFFICE OF
COMPLIANCE AND ENFORCEMENT

SEP 22 2014

Reply to: OCE-084

Certified Mail – Return Receipt Requested

Mr. Jason Jordan
Director, Environmental Programs
Port of Tacoma
P.O. Box 1837
Tacoma, Washington 98401

Re: Self-Implementing On-Site Cleanup and Disposal of Polychlorinated Biphenyl (PCB) Remediation Waste at the Port of Tacoma
1940 East 11th Street Warehouse
Tacoma, Washington 98421

Dear Mr. Jordan:

We have completed our review of the May 29, 2014 Notification and Certification, revised and re-submitted August 26, 2014, that the Port of Tacoma (the Port) intends to conduct a self-implementing cleanup, verification and disposal of PCB remediation waste in accordance with the requirements of 40 C.F.R § 761.61(a).

The August 26, 2014 Notification and Certification is considered the complete Work Plan for the site and is the basis for EPA's approval of the cleanup pursuant to 761.61(a). The Work Plan describes the location and extent of the PCB remediation waste regulated by the Toxic Substances Control Act (TSCA), as well as remediation and disposal plans in accordance with 761.61(a).

PCB remediation waste is present in soils surrounding the perimeter of the warehouse located at 1940 East 11th Street (building) and in stockpiled soils and catch basin cleanout waste (stockpiled materials). The Port maintains that the source of PCBs in soils and in the stockpiled materials is PCB bulk product, specifically PCB contaminated paint applied to the building. The paint is being removed pursuant to 761.62(b), through demolition of the building. The Soils and stockpiled materials are addressed under this approval, pursuant to 761.61(a).

Under the Work Plan the site will be cleaned up to ≤1 ppm PCBs for high occupancy use without further conditions, pursuant to 761.61(a)(4)(i)(A). Remediation activities include excavation and disposal of soil around the perimeter of the building as well as disposal of the stockpiled materials. PCB remediation waste will be managed and disposed of based on the "as-found" concentration. Soil removed from impacted locations with concentrations ≥50 ppm will be disposed of at either a hazardous waste Subtitle C landfill or a TSCA authorized landfill. Soil and stockpiled material with PCB concentrations <50 ppm will be disposed of at an authorized Subtitle D landfill.

In 2012 PCBs were identified in catch basins on-site at concentrations up to 3.8 ppm. Those catch basin solids were removed with a vacuum-truck and stockpiled onsite for future disposal. After removal, filter fabric was put in place on each catch basin to prevent recontamination and is currently maintained. Prior to any remedial activity on site, the Port shall inspect the filter fabric to ensure it is in working order and protective of the catch basins. If any fabric is damaged or improperly installed, the Port shall investigate whether or not PCBs have entered the catch basins, and if so, completely remove and dispose of all PCBs pursuant to either 761.61(b) or 761.61(c). Any PCBs onsite are the responsibility of the Port, and PCBs in a catch basin constitute unauthorized disposal. Therefore, while not required through a 61(a) cleanup and approval, it is strongly recommended that the Port investigate the catch basins for PCB contamination whether or not filter fabric has been damaged. If PCBs have entered the catch basins they must be completely removed and disposed pursuant to either 761.61(b) or 761.61(c).

Soil excavation will take place prior to building demolition. The exterior building walls are connected to foundation footings that are variable in width and depth. The Work Plan explains that excavation will proceed with an understanding that the concrete footings could constrain the excavation depth in some places. When verification sampling identifies soils that require excavation to ensure compliance with the approved cleanup level, but the excavation is constrained by the location of building footings, the initial extent of excavation will be adjusted in the field since the exact location of the footings will not be known before excavation begins. Although not explicitly stated in the Work Plan, this may effectively result in some soil being left in place until after the building is demolished and the footings removed. Once the footings are removed the Port shall remove any soil identified through confirmation sampling to contain PCBs >1 ppm to meet the terms of this approval.

Given that building walls coated in PCB contaminated paint will be torn down, the potential to re-contaminate the site exists during the demolition process. Grant Hainsworth of Crete Consulting, a representative of the Port described the intent of the Port to use fabric or other sheeting on the ground prior to building demolition to prevent distribution of PCB contaminated paint to the surrounding surfaces. EPA notes that any release of PCB contaminated paint from the building to the ground is unauthorized disposal. Further, upon release to the environment the paint and any affected media is considered PCB remediation waste and must be cleaned up and disposed of under 761.61 rather than 761.62 for PCB bulk product waste.

Work may begin September 26, 2014. All work related to removal and verification of cleanup of PCBs at the site is expected to comply with the details presented in the Work Plan, as well as any conditions below, and any other applicable requirements of 40 C.F.R. 761.
Based on our review, your Notification and Work Plan are approved subject to the following conditions and as modified by resolution of the deficiencies identified in Enclosure 1:

1. As stated in 40 C.F.R § 761.61(a), you must conduct the cleanup in accordance with all applicable requirements of 40 C.F.R § 761.61(a)(1) through (9). A copy of those requirements is enclosed (Enclosure 1) for your convenience. To assist you in completing the cleanup successfully, we have placed an "X" in the margin to identify specific requirements for which your notice is deficient in describing how you plan to comply. Specific comments about each of the deficient areas are noted in bold italics following the regulatory citation.
2. You must prepare a cleanup completion summary report that describes how you conducted the cleanup in accordance with the applicable regulatory requirements, including those marked with an "X" on the enclosure. You must send a copy to Michelle Mullin, of my staff within 120 days after disposal verification is received and final sample results validation is completed.
3. Enclosed is a subset of the ASTM Standard Guide for Greener Cleanups (Guide, Enclosure 2). Please see section 6 of the Guide for the Best Management Practices (BMP) Process. BMP opportunities applicable to this cleanup have been highlighted on the Greener Cleanup BMP

Table, Appendix X3 of the Guide, though other BMPs in the full Guide may also be applicable. EPA encourages you to review the Guide and implement any practices that are feasible. The cleanup completion report should include a section on BMP Documentation, as described in Section 6.6.5.

Please note that this approval does not relieve you from your duty to comply with all other applicable federal, state, and local requirements. In addition, please note that if you wish to make any changes to your notification (including changes in the project schedule), you must submit your proposal to Michelle Mullin, of my staff, in writing no less than 14 calendar days prior to the proposed implementation of the change. If you have any questions, please contact her by e-mail at mullin.michelle@epa.gov or by telephone at (206) 553-1616.

Sincerely,

Kelly McFadden

Kelly McFadden, Manager
Pesticides and Toxics Unit

Enclosures

ENCLOSURE

Regulatory Requirements of 40 CFR 761.61(a)

Please note that an "X" in the margin [ ] indicates that the notification and certification of your intention to conduct a self-implementing cleanup does not adequately explain how you intend to comply with the regulatory requirement.

[**X**] (1) ***Applicability***

(i) The self-implementing procedures may not be used to clean up:

(A) Surface or ground waters.

(B) Sediments in marine and freshwater ecosystems.

(C) Sewers or sewage treatment systems.

(D) Any private or public drinking water sources or distribution systems.

(E) Grazing lands.

(F) Vegetable gardens.

In 2012 PCBs were identified in catch basins on-site at concentrations up to 3.8 ppm. Those catch basin solids were removed with a vacuum-truck and stockpiled onsite for future disposal. After removal, filter fabric was put in place on each catch basin to prevent recontamination and is currently maintained. Prior to any remedial activity on site, the Port shall inspect the filter fabric to ensure it is in working order and protective of the catch basins. If any fabric is damaged or improperly installed, the Port shall investigate whether or not PCBs have entered the catch basins, and if so, completely remove and dispose of all PCBs pursuant to either 761.61(b) or 761.61(c). Any PCBs onsite are the responsibility of the Port, and PCBs in a catch basin constitute unauthorized disposal. Therefore, while not required through a 61(a) cleanup and approval, it is strongly recommended that the Port investigate the catch basins for PCB contamination whether or not filter fabric has been damaged. If PCBs have entered the catch basins they must be completely removed and disposed pursuant to either 761.61(b) or 761.61(c).

[ ] (ii) The self-implementing cleanup provisions shall not be binding upon cleanups conducted under other authorities, including but not limited to, actions conducted under section 104 or section 106 of CERCLA, or section 3004(u) and (v) or section 3008(h) of RCRA.

[ ] (2) ***Site characterization***. Any person conducting self-implementing cleanup of PCB remediation waste must characterize the site adequately to be able to provide the information required by paragraph (a)(3) of this section. Subpart N of this part provides a method for collecting new site characterization data or for assessing the sufficiency of existing site characterization data.

[ ] (3) ***Notification and certification***.

[ ] (i) At least 30 days prior to the date that the cleanup of a site begins, the person in charge of the cleanup or the owner of the property where the PCB remediation waste is located shall notify, in writing, the EPA Regional Administrator, the Director of the State or Tribal environmental protection agency, and the Director of the county or local environmental protection agency where the cleanup will be conducted. The notice shall include:

[ ] (A) The nature of the contamination, including kinds of materials contaminated.

[ ] (B) A summary of the procedures used to sample contaminated and adjacent areas and a table or cleanup site map showing PCB concentrations measured in all pre-cleanup characterization

samples. The summary must include sample collection and analysis dates. The EPA Regional Administrator may require more detailed information including, but not limited to, additional characterization sampling or all sample identification numbers from all previous characterization activities at the cleanup site.

[ ] (C) The location and extent of the identified contaminated area, including topographic maps with sample collection sites cross referenced to the sample identification numbers in the data summary from paragraph (a)(3)(i)(B) of this section.

[ ] (D) A cleanup plan for the site, including schedule, disposal technology, and approach. This plan should contain options and contingencies to be used if unanticipated higher concentrations or wider distributions of PCB remediation waste are found or other obstacles force changes in the cleanup approach.

[ ] (E) A written certification, signed by the owner of the property where the cleanup site is located and the party conducting the cleanup, that all sampling plans, sample collection procedures, sample preparation procedures, extraction procedures, and instrumental/chemical analysis procedures used to assess or characterize the PCB contamination at the cleanup site, are on file at the location designated in the certificate, and are available for EPA inspection. Persons using alternate methods for chemical extraction and chemical analysis for site characterization must include in the certificate a statement that such a method will be used and that a comparison study which meets or exceeds the requirements of subpart Q of this part, and for which records are on file, has been completed prior to verification sampling.

[ ] (ii) Within 30 calendar days of receiving the notification, the EPA Regional Administrator will respond in writing approving of the self-implementing cleanup, disapproving of the self-implementing cleanup, or requiring additional information. If the EPA Regional Administrator does not respond within 30 calendar days of receiving the notice, the person submitting the notification may assume that it is complete and acceptable and proceed with the cleanup according to the information the person provided to the EPA Regional Administrator. Once cleanup is underway, the person conducting the cleanup must provide any proposed changes from the notification to the EPA Regional Administrator in writing no less than 14 calendar days prior to the proposed implementation of the change. The EPA Regional Administrator will determine in his or her discretion whether to accept the change, and will respond to the change notification verbally within 7 calendar days and in writing within 14 calendar days of receiving it. If the EPA Regional Administrator does not respond verbally within 7 calendar days and in writing within 14 calendar days of receiving the change notice, the person who submitted it may deem it complete and acceptable and proceed with the cleanup according to the information in the change notice provided to the EPA Regional Administrator.

[ ] (iii) Any person conducting a cleanup activity may obtain a waiver of the 30-day notification requirement, if they receive a separate waiver, in writing, from each of the agencies they are required to notify under this section. The person must retain the original written waiver as required in paragraph (a)(9) of this section.

[ ] (4) ***Cleanup levels***. For purposes of cleaning, decontaminating, or removing PCB remediation waste under this section, there are four general waste categories: bulk PCB remediation waste, non-porous surfaces, porous surfaces, and liquids. Cleanup levels are based on the kind of material and the potential exposure to PCBs left after cleanup is completed.

[ ] (i) *Bulk PCB remediation waste*. Bulk PCB remediation waste includes, but is not limited to, the following non-liquid PCB remediation waste: soil, sediments, dredged materials, muds, PCB sewage sludge, and industrial sludge.

[ ] (A) *High occupancy areas*. The cleanup level for bulk PCB remediation waste in high occupancy areas is ≤1 ppm without further conditions. High occupancy areas where bulk PCB remediation waste remains at concentrations >1 ppm and ≤10 ppm shall be covered with a cap meeting the requirements of paragraphs (a)(7) and (a)(8) of this section.

[ ] (B) *Low occupancy areas*.

[ ] (1) The cleanup level for bulk PCB remediation waste in low occupancy areas is ≤25 ppm unless otherwise specified in this paragraph.

[ ] (2) Bulk PCB remediation wastes may remain at a cleanup site at concentrations >25 ppm and ≤50 ppm if the site is secured by a fence and marked with a sign including the M_L mark.

[ ] (3) Bulk PCB remediation wastes may remain at a cleanup site at concentrations >25 ppm and ≤100 ppm if the site is covered with a cap meeting the requirements of paragraphs (a)(7) and (a)(8) of this section.

[ ] (ii) *Non-porous surfaces*. In high occupancy areas, the surface PCB cleanup standard is ≤ 10 µg/100 cm^2 of surface area. In low occupancy areas, the surface cleanup standard is <100 µg/100 cm^2 of surface area. Select sampling locations in accordance with subpart P of this part or a sampling plan approved under paragraph (c) of this section.

[ ] (iii) *Porous surfaces*. In both high and low occupancy areas, any person disposing of porous surfaces must do so based on the levels in paragraph (a)(4)(i) of this section. Porous surfaces may be cleaned up for use in accordance with §761.79(b)(4) or §761.30(p).

[ ] (iv) *Liquids*. In both high and low occupancy areas, cleanup levels are the concentrations specified in §761.79(b)(1) and (b)(2).

[ ] (v) *Change in the land use for a cleanup site*. Where there is an actual or proposed change in use of an area cleaned up to the levels of a low occupancy area, and the exposure of people or animal life in or at that area could reasonably be expected to increase, resulting in a change in status from a low occupancy area to a high occupancy area, the owner of the area shall clean up the area in accordance with the high occupancy area cleanup levels in paragraphs (a)(4)(i) through (a)(4)(iv) of this section.

[ ] (vi) The EPA Regional Administrator, as part of his or her response to a notification submitted in accordance with §761.61(a)(3) of this part, may require cleanup of the site, or portions of it, to more stringent cleanup levels than are otherwise required in this section, based on the proximity to areas such as residential dwellings, hospitals, schools, nursing homes, playgrounds, parks, day care centers, endangered species habitats, estuaries, wetlands, national parks, national wildlife refuges, commercial fisheries, and sport fisheries.

[ ] (5) ***Site cleanup.*** In addition to the options set out in this paragraph, PCB disposal technologies approved under §§761.60 and 761.70 are acceptable for on-site self-implementing PCB remediation waste disposal within the confines of the operating conditions of the respective approvals.

[ ] (i) *Bulk PCB remediation waste.* Any person cleaning up bulk PCB remediation waste shall do so to the levels in paragraph (a)(4)(i) of this section.

[ ] (A) Any person cleaning up bulk PCB remediation waste on-site using a soil washing process may do so without EPA approval, subject to all of the following:

(1) A non-chlorinated solvent is used.
(2) The process occurs at ambient temperature.
(3) The process is not exothermic.
(4) The process uses no external heat.
(5) The process has secondary containment to prevent any solvent from being released to the underlying or surrounding soils or surface waters.
(6) Solvent disposal, recovery, and/or reuse is in accordance with relevant provisions of approvals issued according to paragraphs (b)(1) or (c) of this section or applicable paragraphs of §761.79.

[ ] (B) Bulk PCB remediation waste may be sent off-site for decontamination or disposal in accordance with this paragraph, provided the waste is either dewatered on-site or transported off-site in containers meeting the requirements of the DOT Hazardous Materials Regulations (HMR) at 49 CFR parts 171 through 180.

[ ] (1) Removed water shall be disposed of according to paragraph (b)(1) of this section.

[ ] (2) Any person disposing off-site of dewatered bulk PCB remediation waste shall do so as follows:

(i) Unless sampled and analyzed for disposal according to the procedures set out in §§761.283, 761.286, and 761.292, the bulk PCB remediation waste shall be assumed to contain ≥50 ppm PCBs.
(ii) Bulk PCB remediation wastes with a PCB concentration of <50 ppm shall be disposed of in accordance with paragraph (a)(5)(v)(A) of this section.
(iii) Bulk PCB remediation wastes with a PCB concentration ≥50 ppm shall be disposed of in a hazardous waste landfill permitted by EPA under section 3004 of RCRA, or by a State authorized under section 3006 of RCRA, or a PCB disposal facility approved under this part.
(iv) The generator must provide written notice, including the quantity to be shipped and highest concentration of PCBs (using extraction EPA Method 3500B/3540C or Method 3500B/3550B followed by chemical analysis using EPA Method 8082 in SW-846 or methods validated under subpart Q of this part) at least 15 days before the first shipment of bulk PCB remediation waste from each cleanup site by the generator, to each off-site facility where the waste is destined for an area not subject to a TSCA PCB Disposal Approval.

[ ] (3) Any person may decontaminate bulk PCB remediation waste in accordance with §761.79 and return the waste to the cleanup site for disposal as long as the cleanup standards of paragraph (a)(4) of this section are met.

[ ] (ii) Non-porous surfaces. PCB remediation waste non-porous surfaces shall be cleaned on-site or off-site for disposal on-site, disposal off-site, or use, as follows:

[ ] (A) For on-site disposal, non-porous surfaces shall be cleaned on-site or off-site to the levels in paragraph (a)(4)(ii) of this section using:

(1) Procedures approved under §761.79.

(2) Technologies approved under §761.60(e).

(3) Procedures or technologies approved under paragraph (c) of this section.

[ ] (B) For off-site disposal, non-porous surfaces:

(1) Having surface concentrations <100 μg/100 cm^2 shall be disposed of in accordance with paragraph (a)(5)(i)(B)(2)(ii) of this section. Metal surfaces may be thermally decontaminated in accordance with §761.79(c)(6)(i).

(2) Having surface concentrations ≥100 μg/100 cm^2 shall be disposed of in accordance with paragraph (a)(5)(i)(B)(2)(iii) of this section. Metal surfaces may be thermally decontaminated in accordance with §761.79(c)(6)(ii).

[ ] (C) For use, non-porous surfaces shall be decontaminated on-site or off-site to the standards specified in §761.79(b)(3) or in accordance with §761.79(c).

[ ] (iii) *Porous surfaces.* Porous surfaces shall be disposed on-site or off-site as bulk PCB remediation waste according to paragraph (a)(5)(i) of this section or decontaminated for use according to §761.79(b)(4), as applicable.

[ ] (iv) *Liquids.* Any person disposing of liquid PCB remediation waste shall either:

(A) Decontaminate the waste to the levels specified in §761.79(b)(1) or (b)(2).

(B) Dispose of the waste in accordance with paragraph (b) of this section or an approval issued under paragraph (c) of this section.

[ ] (v) *Cleanup wastes.* Any person generating the following wastes during and from the cleanup of PCB remediation waste shall dispose of or reuse them using one of the following methods:

[ ] (A) Non-liquid cleaning materials and personal protective equipment waste at any concentration, including non-porous surfaces and other non-liquid materials such as rags, gloves, booties, other disposable personal protective equipment, and similar materials resulting from cleanup activities shall be either decontaminated in accordance with §761.79(b) or (c), or disposed of in one of the following facilities, without regard to the requirements of subparts J and K of this part:

(1) A facility permitted, licensed, or registered by a State to manage municipal solid waste subject to part 258 of this chapter.

(2) A facility permitted, licensed, or registered by a State to manage non-municipal non-hazardous waste subject to §§257.5 through 257.30 of this chapter, as applicable.

(3) A hazardous waste landfill permitted by EPA under section 3004 of RCRA, or by a State authorized under section 3006 of RCRA.

(4) A PCB disposal facility approved under this part.

[ ] (B) Cleaning solvents, abrasives, and equipment may be reused after decontamination in accordance with §761.79.

[ ] (6) ***Cleanup verification*** —

[**X**] (i) *Sampling and analysis.* Any person collecting and analyzing samples to verify the cleanup and on-site disposal of bulk PCB remediation wastes and porous surfaces must do so in accordance with subpart O of this part. Any person collecting and analyzing samples from non-porous surfaces must do so in accordance with subpart P of this part. Any person collecting and analyzing samples from liquids must do so in accordance with §761.269. Any person conducting interim sampling during PCB remediation waste cleanup to determine when to sample to verify that cleanup is complete, may use PCB field screening tests.

The Work Plan contains references to different Relative Percent Difference (RPD) allowances between duplicate samples. EPA requires an RPD of 20% or less.

[**X**] (ii) *Verification.*

(A) Where sample analysis results in a measurement of PCBs less than or equal to the levels specified in paragraph (a)(4) of this section, self-implementing cleanup is complete.

(B) Where sample analysis results in a measurement of PCBs greater than the levels specified in paragraph (a)(4) of this section, self-implementing cleanup of the sampled PCB remediation waste is not complete. The owner or operator of the site must either dispose of the sampled PCB remediation waste, or reclean the waste represented by the sample and reinitiate sampling and analysis in accordance with paragraph (a)(6)(i) of this section.

Soil excavation will take place prior to building demolition. The exterior building walls are connected to foundation footings that are variable in width and depth. The Work Plan explains that excavation will proceed with an understanding that the concrete footings could constrain the excavation depth in some places. When verification sampling identifies soils that require excavation to ensure compliance with the approved cleanup level, but the excavation is constrained by the location of building footings, the initial extent of excavation will be adjusted in the field since the exact location of the footings will not be known before excavation begins. Although not explicitly stated in the Work Plan, this may effectively result in some soil being left in place until after the building is demolished and the footings removed. Once the footings are removed the Port shall remove any soil identified through confirmation sampling to contain PCBs >1 ppm to meet the terms of this approval.

[ ] (7) ***Cap requirements.*** A cap means, when referring to on-site cleanup and disposal of PCB remediation waste, a uniform placement of concrete, asphalt, or similar material of minimum thickness spread over the area where remediation waste was removed or left in place in order to prevent or minimize human exposure, infiltration of water, and erosion. Any person designing and constructing a cap must do so in accordance with §264.310(a) of this chapter, and ensure that it complies with the permeability, sieve, liquid limit, and plasticity index parameters in §761.75(b)(1)(ii) through (b)(1)(v). A cap of compacted soil shall have a minimum thickness of 25 cm (10 inches). A concrete or asphalt cap shall have a minimum thickness of 15 cm (6 inches). A cap must be of sufficient strength to maintain its effectiveness and integrity during the use of the cap surface which is exposed to the environment. A cap shall not be contaminated at a level ≥1 ppm PCB per AroclorTM(or equivalent) or per congener. Repairs shall begin within 72 hours of discovery for any breaches which would impair the integrity of the cap.

[ ] (8) ***Deed restrictions for caps, fences and low occupancy areas.*** When a cleanup activity conducted under this section includes the use of a fence or a cap, the owner of the site must maintain the fence or cap, in perpetuity. In addition, whenever a cap, or the procedures and requirements for a low occupancy area, is used, the owner of the site must meet the following conditions:

[ ] (i) Within 60 days of completion of a cleanup activity under this section, the owner of the property shall:

[ ] (A) Record, in accordance with State law, a notation on the deed to the property, or on some other instrument which is normally examined during a title search, that will in perpetuity notify any potential purchaser of the property:

(1) That the land has been used for PCB remediation waste disposal and is restricted to use as a low occupancy area as defined in §761.3.

(2) Of the existence of the fence or cap and the requirement to maintain the fence or cap.

(3) The applicable cleanup levels left at the site, inside the fence, and/or under the cap.

[ ] (B) Submit a certification, signed by the owner, that he/she has recorded the notation specified in paragraph (a)(8)(i)(A) of this section to the EPA Regional Administrator.

[ ] (ii) The owner of a site being cleaned up under this section may remove a fence or cap after conducting additional cleanup activities and achieving cleanup levels, specified in paragraph (a)(4) of this section, which do not require a cap or fence. The owner may remove the notice on the deed no earlier than 30 days after achieving the cleanup levels specified in this section which do not require a fence or cap.

[ ] (9) ***Recordkeeping***. For paragraphs (a)(3), (a)(4), and (a)(5) of this section, recordkeeping is required in accordance with §761.125(c)(5).

TABLE X3.1 *Continued*

		Core Element Addressed (at Site Level)					Remediation Technology										
Category		Energy	Air	Water	Materials and Waste	Land and Ecosystems	Soil Vapor Extraction	Air Sparging	Pump and Treat	In-situ Chemical Oxidation	Bioremediation/MNA	In-situ Thermal Treatment	Phytotechnology	Subsurface Containment & Treatment Barriers	Excavation and Surface Restoration	Ex-situ Bio/Chemical Oxidation	Vapor Intrusion Mitigation
Materials	Steam-clean or use phosphate-free detergents or biodegradable cleaning products instead of organic solvents or acids to decontaminate sampling equipment			X	X	X	X	X	X	X	X	X	X	X	X	X	X
Materials	Use wood-based materials and products that are certified in accordance with the FSC Principles and Criteria for wood building components				X		X	X	X	X	X	X	X	X	X	X	X
Materials	Use regenerated GAC for use in carbon beds				X		X		X			X					X
Materials	Consider preheating vapors (preferably passive) to reduce relative humidity prior to treatment with vapor-phase GAC to improve adsorption efficiency if preheating does not produce unacceptable tradeoffs				X		X										X
Materials	Salvage uncontaminated objects/ infrastructure with potential recycle, resale, donation, or reuse				X		X	X	X	X	X	X	X	X	X	X	X
Materials	Maximize the reuse of existing wells for sampling, injections or extractions, where appropriate, and/or design wells for future reuse	X	X		X	X	X	X	X	X	X	X					X
Materials	Implement a flexible network of piping (under and/or aboveground) which allows for future modular increases or decreases in the extraction or injection rates and treatment modifications	X			X		X	X	X	X	X	X					X
Materials	Use timers or feedback loops and process controls for dosing chemical injections	X	X		X					X	X					X	
Materials	Use in-well downhole real time data collection systems with remote sensing capabilities for monitoring groundwater parameters to optimize injection of oxidants and reagents	X	X		X			X		X	X						
Materials	Use by-products, waste, or less refined materials from local sources in place of refined chemicals or materials (for example, cheese whey, molasses, compost, or off-spec food products for inducing anaerobic conditions; limestone in place of concentrated sodium hydroxide)	X	X		X					X	X		X			X	
Materials	Select oxidants/reagents with a lower environmental burden				X	X				X	X					X	
Materials	For biomass substrates (for example, algae-based oils, soybean oil, other waste/by-products from forestry, plant nursery, food processing/retail industries) used during in-situ bioremediation, utilize material from providers that can demonstrate use of sustainable techniques	X	X	X	X	X					X					X	
Materials	For in-situ thermal treatment using ERH, recover and recycle or re-use steel electrodes at project completion				X							X					
Materials	Use vegetation in phytoremediation that can sequester carbon for a long time (several decades)		X			X							X				
Materials	Use vegetation, as warranted, as a source of biofuel following completion of phytoremediation project	X			X	X							X				

TABLE X3.1 *Continued*

		Core Element Addressed (at Site Level)					Remediation Technology										
Category		Energy	Air	Water	Materials and Waste	Land and Ecosystems	Soil Vapor Extraction	Air Sparging	Pump and Treat	In-situ Chemical Oxidation	Bioremediation/MNA	In-situ Thermal Treatment	Phytotechnology	Subsurface Containment & Treatment Barriers	Excavation and Surface Restoration	Ex-situ Bio/Chemical Oxidation	Vapor Intrusion Mitigation
Materials	Select well/heater materials and treatment equipment to facilitate reuse. For example, carbon steel casings may resist chlorine stress corrosion better than stainless steel. Prevent condensation in metal extraction piping via pipe insulation, jacketing and heat tracing to preserve equipment. Add caustic where needed to minimize acid corrosion of materials and equipment and thereby enhance their longevity				X		X	X	X	X	X	X					
Materials	Consider co-locating electrodes and recovery wells in the same borehole, particularly in the saturated zone, to minimize the total number of wells and land disturbance	X	X	X	X	X						X					
Materials	Use dedicated materials (that is, reuse of sampling equipment and nonuse of disposable materials/equipment) when performing multiple rounds of sampling				X		X	X	X	X	X	X	X	X	X	X	X
Materials	Purchase materials in bulk quantities and packed in reusable/recyclable containers and drums to reduce packaging waste				X		X	X	X	X	X	X	X	X	X	X	X
Materials	Use products, packing material, and equipment that can be reused or recycled				X		X	X	X	X	X	X	X	X	X	X	X
Materials	Prepare, store, and distribute documents electronically using an environmental information management system				X		X	X	X	X	X	X	X	X	X	X	X
Materials	Recycle as much non-usable/spent equipment/materials as possible following completion of project				X		X	X	X	X	X	X	X	X	X	X	X
Power and Fuel	Conduct pilot tracer tests to optimize hydraulic delivery of reagents and assure capture of target groundwater zone to be treated aboveground	X			X				X	X	X						
Power and Fuel	When possible, operate remediation system during off-peak hours of electrical demand without compromising cleanup progress	X					X	X	X	X		X					
Power and Fuel	Use pulsed rather than continuous injections when delivering or extracting air to increase energy efficiency when nearing asymptotic conditions	X					X	X			X						
Power and Fuel	Use gravity flow where feasible to reduce the number of pumps for water transfer after subsurface extraction	X			X				X								
Power and Fuel	Install amp meters to evaluate consumption rates on a real-time basis to evaluate options for off-peak energy usage	X					X	X	X	X	X	X					
Power and Fuel	Use on-site generated renewable energy (including but not limited to solar photovoltaic, wind turbines, landfill gas, geothermal, biomass combustion, etc.) to fully or partially provide power otherwise achieved through onsite fuel consumption or use of grid electricity	X	X				X	X	X	X	X	X	X	X	X	X	X
Power and Fuel	Insulate all applicable pipes and equipment to improve energy efficiency	X					X		X	X	X	X					
Power and Fuel	Use heat pumps or solar heating in place of electrical resistive heating when preheated extracted groundwater is required prior to treatment	X							X								

TABLE X3.1 *Continued*

Category		Core Element Addressed (at Site Level): Energy	Air	Water	Materials and Waste	Land and Ecosystems	Remediation Technology: Soil Vapor Extraction	Air Sparging	Pump and Treat	In-situ Chemical Oxidation	Bioremediation/MNA	In-situ Thermal Treatment	Phytotechnology	Subsurface Containment & Treatment Barriers	Excavation and Surface Restoration	Ex-situ Bio/Chemical Oxidation	Vapor Intrusion Mitigation
Power and Fuel	Use solar power pack system for low-power system demands (for example, security lighting, system telemetry)	X					X	X	X	X	X	X	X	X	X	X	X
Power and Fuel	Purchase renewable energy via local utility and Green Energy Programs or renewable energy credits/certificates (RECs or Green Tags) to power cleanup activities	X	X				X	X	X	X	X	X	X	X	X	X	X
Power and Fuel	Employ auxiliary power units to power cab heating and air conditioning when a machine is not operating (such as smartway generator or plug in outlet)	X	X				X	X	X	X	X	X	X	X	X	X	X
Power and Fuel	Install a modular renewable energy system that can be used to meet energy demands of multiple activities over the lifespan of the project (for example, powering field equipment, construction or operational activities, supplying energy demands of buildings)	X	X				X	X	X	X	X	X	X	X	X	X	X
Power and Fuel	Use gravity flow to introduce amendments or chemical oxidants to the subsurface when high-pressure injection is unnecessary	X			X					X	X					X	
Power and Fuel	When nearing asymptotic conditions and/or when continuous pumping is not needed to contain the plume and/or reach clean-up objectives, operate pumping equipment in pulsed mode	X					X	X	X	X	X						X
Power and Fuel	Capture on-site waste heat (for example, treatment plant effluent, excess plant steam, ground-source heat pumps, mobile waste-to-heat generators, furnaces/air conditioners operating with recycled oil, etc.) to power cleanup activities	X					X	X	X	X	X	X	X	X	X	X	X
Power and Fuel	Use biodiesel produced from waste or cellulose-based products, preferring local sources wherever readily available to reduce transportation impacts				X		X	X	X	X	X	X	X	X	X	X	X
Power and Fuel	Use permanent injection wells for delivery of chemical oxidants if multiple applications are expected	X			X	X				X	X						
Power and Fuel	For constructed wetlands, maximize use of gravity flow for conveyance of water	X			X						X		X				
Power and Fuel	Use passive sub-slab depressurization system to mitigate vapor intrusion	X															X
Power and Fuel	Use no- or low-mowing species between plantings to minimize mowing	X	X										X		X		
Power and Fuel	Switch to a less energy-intensive technology for remediation polishing when possible (for example, supplement groundwater extraction systems with plant-based groundwater extraction system) when overall energy balance supports the concept	X		X	X	X			X				X				
Power and Fuel	For SEE, use a natural gas-fired boiler rather than a diesel boiler and preheat water delivered to boiler, if possible, using recycled heat from extracted fluids	X										X					
Power and Fuel	Insulate the surface of the TTZ to reduce energy losses and use greener insulation alternatives such as LECA beads rather than polyurethane foam	X			X							X					

TABLE X3.1 *Continued*

Category		Core Element Addressed (at Site Level)					Remediation Technology										
		Energy	Air	Water	Materials and Waste	Land and Ecosystems	Soil Vapor Extraction	Air Sparging	Pump and Treat	In-situ Chemical Oxidation	Bioremediation/MNA	In-situ Thermal Treatment	Phytotechnology	Subsurface Containment & Treatment Barriers	Excavation and Surface Restoration	Ex-situ Bio/Chemical Oxidation	Vapor Intrusion Mitigation
Project Planning and Team Management	Select facilities with green policies for worker accommodations and periodic meetings	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
Project Planning and Team Management	Use local staff (including subcontractors) when possible to minimize resource consumption	X	X		X		X	X	X	X	X	X	X	X	X	X	X
Project Planning and Team Management	Buy carbon offset credits (for example, for airline flights) when in person meetings are required		X				X	X	X	X	X	X	X	X	X	X	X
Project Planning and Team Management	Establish green requirements (for example, SMPs and BMPs) as evaluation criteria in the selection of contractors and include language in RFPs, RFQs, subcontracts, contracts, etc.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Project Planning and Team Management	Plant at the optimum time of the season (for example, late winter/early spring) to minimize irrigation requirements and increase acclimation survivability	X		X	X	X							X		X		
Project Planning and Team Management	Develop a contingency plan that maximizes the replanting needs while minimizing re-mobilization	X			X	X							X		X		
Project Planning and Team Management	Surgically TTZ and select appropriate performance standards to minimize volume requiring treatment relative to remedial goals	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Project Planning and Team Management	Perform a heat and energy balance calculation to optimize heating and extraction rates which require an adequate characterization of site hydraulics/hydrogeology. Maintain the energy balance on a daily basis during operation and adjust extraction strategy accordingly and minimize unnecessary operation period	X										X					
Residual Solid and Liquid Waste	Minimize off-site disposal of solid waste by improving solids dewatering with a filter press or other technologies	X	X		X		X	X	X	X	X	X	X	X	X	X	X
Residual Solid and Liquid Waste	Reuse or recycle recovered product (such as resale of captured petroleum products, precipitated metals, etc.) and materials (for example, cardboard, plastics, asphalt, concrete, etc.)				X				X				X		X		
Residual Solid and Liquid Waste	Use filters (for example, bag/cartridge filters) that can be backwashed to avoid frequent disposal of filters				X		X		X								
Residual Solid and Liquid Waste	Use geotextile bags or nets to contain excavated sediment, facilitate sediment drying, and increase ease of sediment placement or transport, when appropriate			X		X	X	X	X	X	X	X	X	X	X	X	
Residual Solid and Liquid Waste	Segregate drilling waste based on location/composition to reduce the volume of drilling waste disposed off-site; collect needed analytical data to make on-site reuse decisions	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
Residual Solid and Liquid Waste	Use alternative drilling methods including DPT or sonic for well drilling to minimize drill cuttings that require disposal	X	X		X	X	X	X	X	X	X	X					

TABLE X3.1 *Continued*

Category		Core Element Addressed (at Site Level)					Remediation Technology										
		Energy	Air	Water	Materials and Waste	Land and Ecosystems	Soil Vapor Extraction	Air Sparging	Pump and Treat	In-situ Chemical Oxidation	Bioremediation/MNA	In-situ Thermal Treatment	Phytotechnology	Subsurface Containment & Treatment Barriers	Excavation and Surface Restoration	Ex-situ Bio/Chemical Oxidation	Vapor Intrusion Mitigation
Residual Solid and Liquid Waste	Provide on-site collection and storage area for compostable materials for use on-site or by the local community				X	X	X	X	X	X	X	X	X	X	X	X	X
Residual Solid and Liquid Waste	Minimize soil excavation during installation of in-situ reactive barriers by using existing excavation, deep soil mixing, injection or other subsurface infrastructure				X	X								X	X		
Sampling and Analysis	Use direct sensing non-invasive, technology such as a membrane interface probe, X-ray fluorescence, LIF sensor, CPT, ROST, FFD, MIP and/or seismic refraction/reflection	X			X	X	X	X	X	X	X	X	X	X	X	X	X
Sampling and Analysis	Use field test kits for screening analysis of soil and groundwater contaminants such as petroleum, polychlorinated biphenyls, pesticides, explosives, and inorganics to minimize the need for offsite laboratory analysis and associated sample packing and shipping	X	X		X		X	X	X	X	X	X	X	X	X	X	X
Sampling and Analysis	Use on-site mobile lab or other field analysis (for example, portable gas chromatography/mass spectrometry for fuel-related compounds and VOCs) to minimize the need for offsite laboratory analysis and associated sample packing and shipping	X	X		X		X	X	X	X	X	X	X	X	X	X	X
Sampling and Analysis	Contract a laboratory that uses green practices and/or chemicals	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sampling and Analysis	Use multi-port sampling system in monitoring wells to minimize the number of wells needing to be installed				X	X		X	X	X	X	X	X	X			
Sampling and Analysis	Use tree core sampling to estimate the source/extent and/or age of a contaminant (for example, metals, VOCs, SVOCs) plume	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
Sampling and Analysis	Use local laboratory to minimize impacts from transportation	X	X				X	X	X	X	X	X	X	X	X	X	X
Sampling and Analysis	Use passive/no purge groundwater sampling system			X	X			X	X	X	X	X	X	X			
Sampling and Analysis	Use stressed vegetation to locate contaminant hotpsots to guide development of sampling and analysis plans and optimize design of monitoring well network	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X
Site Preparation/ Land Restoration	Revegetate excavated areas and/or areas disrupted by equipment or vehicles as quickly as possible using native vegetation, if possible, and restore as close as possible to original conditions			X		X	X	X	X	X	X	X	X	X	X	X	X
Site Preparation/ Land Restoration	Survey on-site infrastructure to determine material types and approximate quantities that could be reused or recycled and evaluate opportunities for on-site or local re-use and/or recycling				X	X	X	X	X	X	X	X	X	X	X	X	X
Site Preparation/ Land Restoration	Minimize use of pesticides through the use of green alternatives (for example, non-chemical solarizing technique) and an integrated pesticide management plan				X	X									X		
Site Preparation/ Land Restoration	Minimize clearing of trees throughout investigation and cleanup	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X

TABLE X3.1 *Continued*

		Core Element Addressed (at Site Level)					Remediation Technology										
Category		Energy	Air	Water	Materials and Waste	Land and Ecosystems	Soil Vapor Extraction	Air Sparging	Pump and Treat	In-situ Chemical Oxidation	Bioremediation/MNA	In-situ Thermal Treatment	Phytotechnology	Subsurface Containment & Treatment Barriers	Excavation and Surface Restoration	Ex-situ Bio/Chemical Oxidation	Vapor Intrusion Mitigation
Site Preparation/ Land Restoration	Maximize use of native, non-invasive and/or drought resistant vegetative cover across the site during restoration using a suitable mix of shrubs, grasses, and forbs to preserve biodiversity and related ecosystem services			X		X	X	X	X	X	X	X	X	X	X	X	X
Site Preparation/ Land Restoration	Minimize soil compaction and land disturbance during site activities by restricting traffic to confined corridors and protecting ground surfaces with biodegradable covers, where applicable			X		X	X	X	X	X	X	X	X	X	X	X	X
Site Preparation/ Land Restoration	Reclaim and stockpile uncontaminated soil for use as fill or other purposes such as frost prevention and erosion control layers in landfill covers				X	X	X	X	X	X	X	X	X	X	X	X	X
Site Preparation/ Land Restoration	Salvage uncontaminated and pest- or disease-free organic debris, including trees downed during site clearing, for use as fill, mulch, compost, or habitat creation				X	X	X	X	X	X	X	X	X	X	X	X	X
Site Preparation/ Land Restoration	Cover filled excavations with biodegradable fabric to control erosion and serve as a substrate for ecosystems			X		X							X	X	X	X	X
Site Preparation/ Land Restoration	Enhance existing natural resources, manage surface drainage, prevent soil/ sediment runoff and promote carbon sequestration by incorporating wetlands, bioswales, and other types of vegetation into overall remedial approach		X	X		X							X	X			
Site Preparation/ Land Restoration	Restore and maintain surface water banks in ways that mirror natural conditions			X		X							X		X	X	
Site Preparation/ Land Restoration	Use onsite or nearby sources of backfill material for excavated areas, if shown to be free of contaminants	X	X		X		X	X	X	X	X	X	X	X	X	X	X
Site Preparation/ Land Restoration	Use onsite uncontaminated sand, gravel, and rocks for drainage within landfill cover	X	X	X	X										X		
Site Preparation/ Land Restoration	Use remotely controlled or non-invasive techniques to monitor landfill cover integrity; for example, use open path spectroscopy techniques to periodically confirm no escape of landfill gas	X	X		X										X		X
Site Preparation/ Land Restoration	Use horizontal wells to distribute chemicals/additives to optimize delivery of materials and minimize surficial footprint					X				X	X						
Site Preparation/ Land Restoration	When canopy closure has reached high percentage (for example, 75+%) allow naturalization to occur (that is, do not remove downed trees/branches except for safety/access issues, allow leaf litter to lay to create forest floor providing natural mulching and weed control)			X	X	X							X		X		
Site Preparation/ Land Restoration	Design systems to allow natural volunteer growth/spreading to fill in entire target area over time (minimize initial planting; fill in over time), if time permits			X	X	X							X		X		

TABLE X3.1 *Continued*

		Core Element Addressed (at Site Level)					Remediation Technology										
Category		Energy	Air	Water	Materials and Waste	Land and Ecosystems	Soil Vapor Extraction	Air Sparging	Pump and Treat	In-situ Chemical Oxidation	Bioremediation/MNA	In-situ Thermal Treatment	Phytotechnology	Subsurface Containment & Treatment Barriers	Excavation and Surface Restoration	Ex-situ Bio/Chemical Oxidation	Vapor Intrusion Mitigation
Site Preparation/ Land Restoration	Use Smartway transportation retrofits (for example skirts, air tabs) on tractor-trailers whenever possible	X	X				X	X	X	X	X	X	X	X	X	X	X
Site Preparation/ Land Restoration	Use minimum slope while maintaining proper drainage in design of landfllls to reduce the volume of fill material required				X	X									X		
Site Preparation/ Land Restoration	Use lower permeability soils than required by regulation in landfill cover design when soils are available locally to reduce the amount of leachate generated	X		X	X										X		
Surface/ Storm Water	Install and maintain silt fences and basins to capture sediment runoff along sloped areas			X		X	X	X	X	X	X	X	X	X	X	X	X
Surface/ Storm Water	Use a leachate collection system for a landfarm (along with a leachate treatment system) to fully preserve the quality of downgradient water bodies, soil, and groundwater			X		X					X				X		
Surface/ Storm Water	Use captured rainwater for tasks such as wash water, irrigation, dust control, constructed wetlands, or other uses			X		X	X	X	X	X	X	X	X	X	X	X	X
Surface/ Storm Water	Use excavated areas to serve as retention basins in final storm water control plans			X	X	X	X	X	X	X	X	X	X	X	X	X	X
Surface/ Storm Water	Install a landfarm rain shield (such as a plastic tunnel) with rain barrels or a cistern to capture precipitation for potential onsite use			X											X	X	
Surface/ Storm Water	Use gravel roads, porous pavement, and separated pervious surfaces rather than impermeable materials to maximize infiltration			X		X	X	X	X	X	X	X	X	X	X	X	X
Surface/ Storm Water	Install earthen berm on landfill covers that utilize onsite/local materials to manage run-on and/or run-off storm water	X	X		X								X		X	X	
Surface/ Storm Water	Use subsurface/vertical flow wetlands rather than surface flow wherever possible to minimize alterations to existing land surface conditions or ongoing activities and to allow use of a greater range of plant species			X		X							X				
Vehicles and Equipment	Install one-way check valves in well casing to promote barometric pumping (passive SVE) as a polishing step once the bulk of contamination has been removed if venting to atmosphere is acceptable	X					X	X									X
Vehicles and Equipment	Use centrifugal blowers, rather than positive displacement blowers and intake air line mufflers, to decrease noise levels					X	X	X									X
Vehicles and Equipment	Use variable frequency drive motors to automatically adjust energy use to meet system demand on blowers, vacuum pumps, etc. that accommodate changes in operating requirements as treatment progresses	X					X	X	X			X					X
Vehicles and Equipment	Use equipment to increase automation such as electronic pressure transducers, thermo-couples, and water quality monitoring devices coupled with an automatic data logger	X	X	X			X	X	X	X	X	X					X

TABLE X3.1 *Continued*

		Core Element Addressed (at Site Level)					Remediation Technology										
Category		Energy	Air	Water	Materials and Waste	Land and Ecosystems	Soil Vapor Extraction	Air Sparging	Pump and Treat	In-situ Chemical Oxidation	Bioremediation/MNA	In-situ Thermal Treatment	Phytotechnology	Subsurface Containment & Treatment Barriers	Excavation and Surface Restoration	Ex-situ Bio/Chemical Oxidation	Vapor Intrusion Mitigation
Vehicles and Equipment	Use biodegradable hydraulic fluids on hydraulic equipment such as drill rigs				X		X	X	X	X	X	X	X	X	X	X	X
Vehicles and Equipment	Implement an idle reduction plan	X	X			X	X	X	X	X	X	X	X	X	X	X	
Vehicles and Equipment	Minimize diesel emissions through the use of retrofitted engines, ultra-low or low sulfur diesel or alternative fuels, or filter/treatment devices to achieve BACT or MACT		X				X	X	X	X	X	X	X	X	X	X	X
Vehicles and Equipment	Soundproof all aboveground equipment housing to prevent noise disturbance to surrounding environment					X	X	X	X	X		X					X
Vehicles and Equipment	Implement a telemetry system to reduce frequency of site visits	X	X				X	X	X	X	X	X	X	X	X	X	X
Vehicles and Equipment	Replace conventional vehicles with electric, hybrid, ethanol, or compressed natural gas vehicles	X	X				X	X	X	X	X	X	X	X	X	X	X
Vehicles and Equipment	Mix amendements into soil in situ whenever possible to minimize dust generation and emissions		X			X								X	X		
Wastewater	Redirect influx of upgradient groundwater into the treatment area by adding engineering controls (for example, installation of subsurface barriers to divert groundwater)	X		X								X		X			
Wastewater	Use seasonal removal (for example, cold and/or dry) or ground-freezing technologies, if environmentally beneficial, to minimize dewatering prior to excavation	X			X									X	X	X	
Wastewater	Reinject treated groundwater to the subsurface to recharge an aquifer			X					X								
Wastewater	Reclaim clean or treated water from other site activities for use in injection slurries or as injection chase water			X	X		X	X	X	X		X		X			
Wastewater	Use treated slurry and/or process water for other cleanup activities or non-remedial applications such as irrigation or wetlands enhancement			X	X				X		X		X		X	X	
Wastewater	Use dewatering processes that maximize water reuse			X	X									X	X	X	
Wastewater	Treat condensate in onsite systems where contaminant types and concentrations permit rather than have them shipped offsite for treatment	X	X				X	X	X			X					X
Wastewater	Recycle condenser water as supplemental cooling water where contaminant concentrations permit			X	X		X	X	X			X					X
Wastewater	Treat potentially contaminated purge water with an on-site treatment technique prior to reinjecting into an on-site well or discharge to a storm drain or waterway, as permissible	X	X		X			X	X	X	X	X	X	X			
Wastewater	Use uncontaminated wastewater or treated water for tasks such as wash water, irrigation, dust control, constructed wetlands, or other uses			X	X		X	X	X	X	X	X	X	X			
Wastewater	Employ closed-loop graywater washing system for decontamination of trucks			X	X		X	X	X	X	X	X	X	X	X	X	