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2007 SB14 Source Reduction Plan/Report

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Lawrence Livermore National Laboratory
2007 SB14 Source Reduction Plan/Report

PRA07-067

SB14 Source Reduction Plan
Category A Wastes

CWC 132: Aqueous Solution With Metals

Site	2006 quantity (lb)
LLNL	142,230

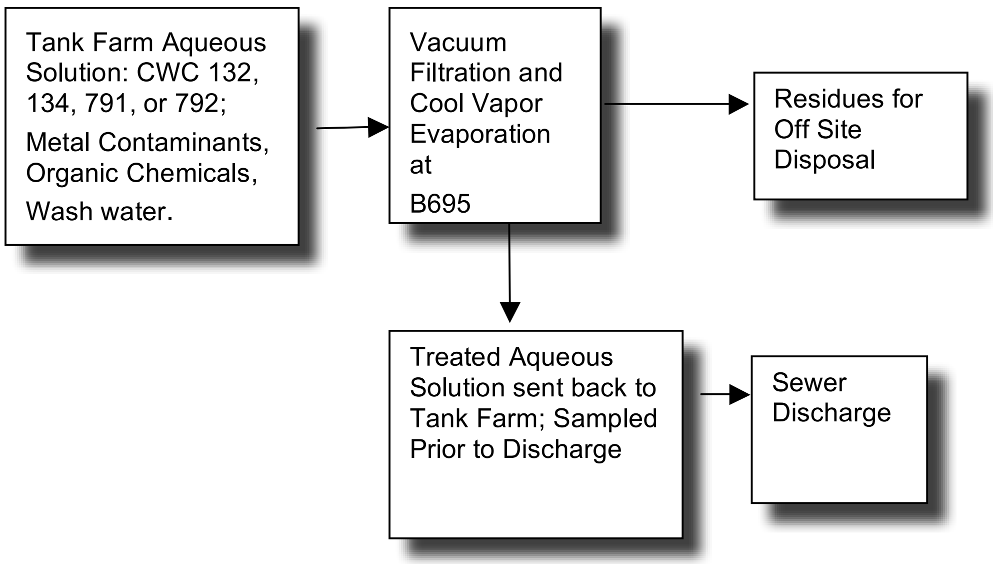

FIGURE 1. CWC 132 PROCESS FLOW DIAGRAM FOR TANK FARM AQUEOUS SOLUTION TREATMENT PROCESS

Aqueous solutions (mixed waste) generated from various LLNL operations, such as debris washing, sample preparation and analysis, and equipment maintenance and cleanout, were combined for storage in the B695 tank farm. Prior to combination the individual waste streams had different codes depending on the particular generating process and waste characteristics. The largest streams were CWC 132, 791, 134, 792. Several smaller waste streams were also included.

This combined waste stream was treated at LLNL's waste treatment facility using a vacuum filtration and cool vapor evaporation process in preparation for discharge to sanitary sewer. Prior to discharge, the treated waste stream was sampled and the results were reviewed by LLNL's water monitoring specialists. The treated solution was discharged following confirmation that it met the discharge criteria.

SOURCE REDUCTION/POLLUTION PREVENTION EVALUATION
LLNL plans to continue the existing best management practices to reduce wash water used in a variety of system rinsing and debris washing processes around the site whenever possible.

Category B Wastes

CWC 132: Aqueous Solution With Metals

Site	2006 quantity (lb)
LLNL	32,985

Industrial Machines Operations

Site	2006 quantity (lb)
LLNL	16,350

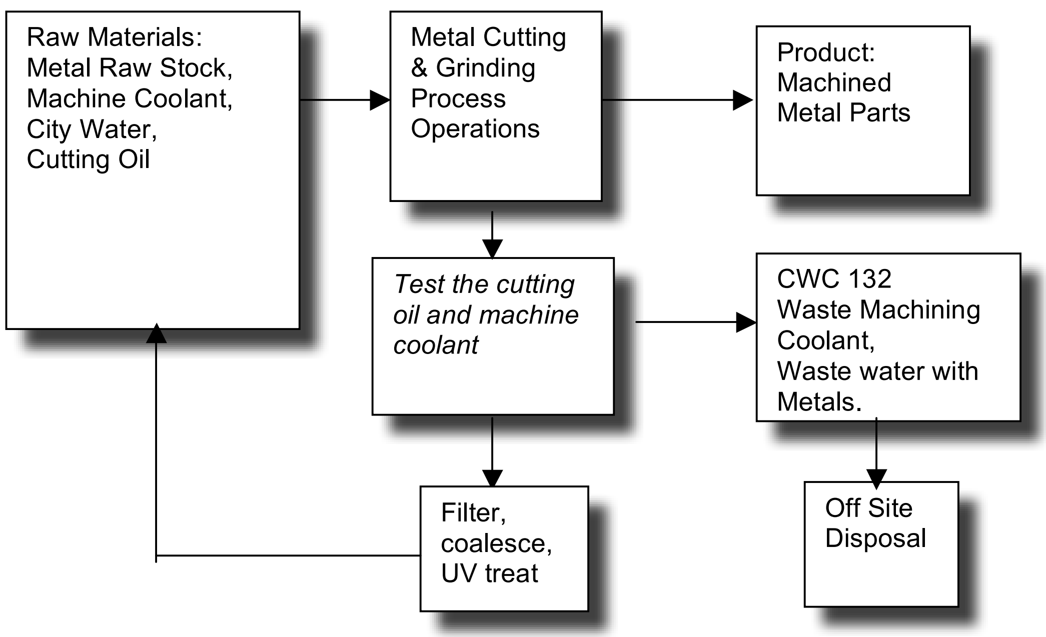

FIGURE 2. CWC 132 PROCESS FLOW DIAGRAM FOR INDUSTRIAL MACHINES OPERATIONS

A major source, accounting for 50% for this waste stream, is metal machining, cutting and grinding operations in the engineering machine shops in B321/B131. An additional 7% was from similar operations in B131 and B132S. This waste stream primarily contains metal cuttings from machined parts, machining coolant and water, with small amounts of tramp oil from the machining and grinding equipment.

Several waste reduction measures for the B321 machine shop have been taken, including the use of a small point-of-use filtering/tramp-oil coalescing/UV-sterilization coolant recycling unit, and improved management techniques (testing and replenishing) for coolants. The recycling unit had some operational problems during 2006. The machine shop is planning to have it repaired in the near future.

Quarterly waste generation data prepared by the Environmental Protection Department's P2 Team are regularly provided to engineering shops as well as other facilities so that generators can track the effectiveness of their waste minimization efforts.

SOURCE REDUCTION/POLLUTION PREVENTION EVALUATION
Description of Measure: LLNL plans to continue the existing source reduction measures and best management practices. No other source reduction measures are planned at this time.

B321A/B322 Plating Shops Operations

Site	2006 quantity (lb)
LLNL	13,813

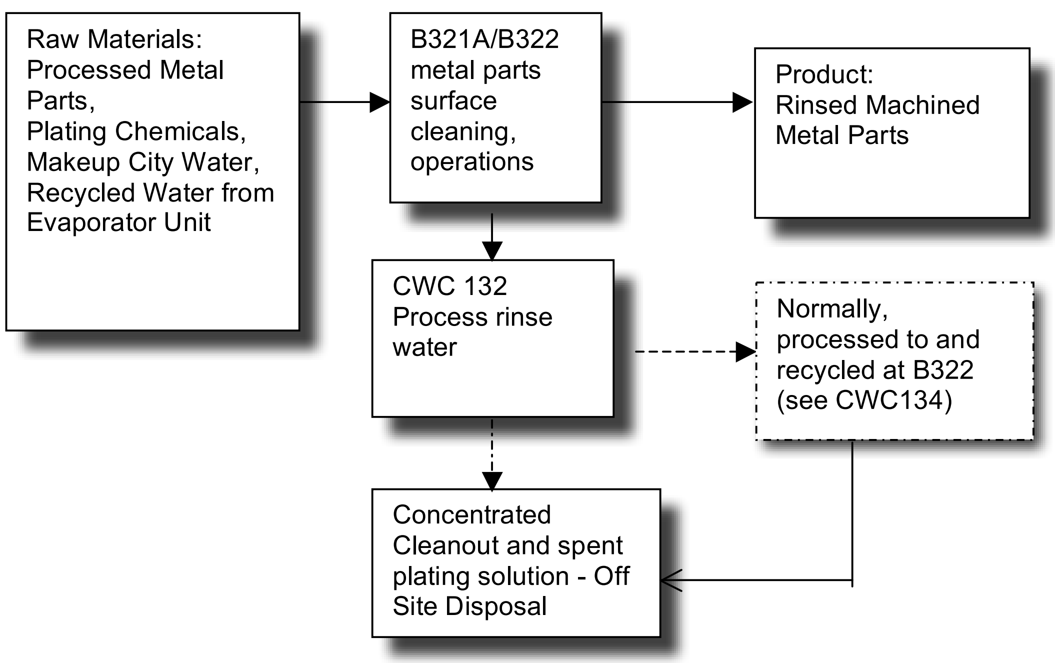

FIGURE 3. CWC 132 BUILDING 321A/B322 PLATING SHOPS FLOW DIAGRAM FOR RINSE WATER RECYCLING PROCESS.

The LLNL plating shops in B321A/B322 employ different processes to serve the needs of the research and development activities at LLNL site. Shop activities, including metal plating, acid etching, and rinsing processes, which are done to strict customers specifications.

As the plating activities are research oriented, they can generate multiple types of spent plating solutions and rinse-water. This waste stream can have one code or multiple codes, such as CWC 132, 134, 721, 723, or 726 depending on the particular process and characteristic of the waste. The plating shops employ methods to extend the life of the plating baths by using spray rinsing that minimizes drag out, and other methods to reduce contamination. However, once these baths no longer meet specifications, the solutions are containerized and shipped off-site for treatment and disposal at authorized facilities.

Water used for rinsing of processed parts in the B321A/B322 plating shops is typically contaminated with the organic chemicals and hazardous metals used in plating operations. While the plating shops employs pollution prevention approaches such as spray versus immersion rinsing of parts, segregation of waste streams, and ultrasonic cleaning techniques, a considerable volume of rinse water is still used. The wastewater generated from the rinsing process is normally not disposed of; it is almost completely recycled using the evaporator unit at B322 (see discussion in CWC 134 section). The recovered water is reused in the B322 plating shop.

The CWC 132 aqueous solution that was not recycled in 2006 consisted of the concentrate generated from the evaporator cleanout and spent plating solutions. The aqueous solution shipped offsite for treatment and disposal was approximately 42% of the total CWC 132 waste stream in Category B (nearly 7% was from B321A).

SOURCE REDUCTION/POLLUTION PREVENTION EVALUATION
<u>Description of Measure:</u> LLNL plans to continue recycling rinse water (CWC 132 and 134 waste streams) generated at B321A and B322 through the B322 evaporator unit and continue best management practices that extend the life of the plating baths. No other source reduction measures are planned at this time.

Miscellaneous aqueous solutions generated from other LLNL operations accounted for approximately 8% of the total CWC 132 waste stream. They were shipped offsite for treatment and disposal in 2006. LLNL plans to continue the existing best management practices to minimize these solutions. No other source reduction measures are planned at this time.

CWC 134: Aqueous Solution With Total Organic Residues Less Than 10 Percent

Site	2006 quantity (lb)
LLNL	1,396,888

B322 Plating Shop Rinse water Recycling

Site	2006 quantity (lb)
LLNL	1,344,102

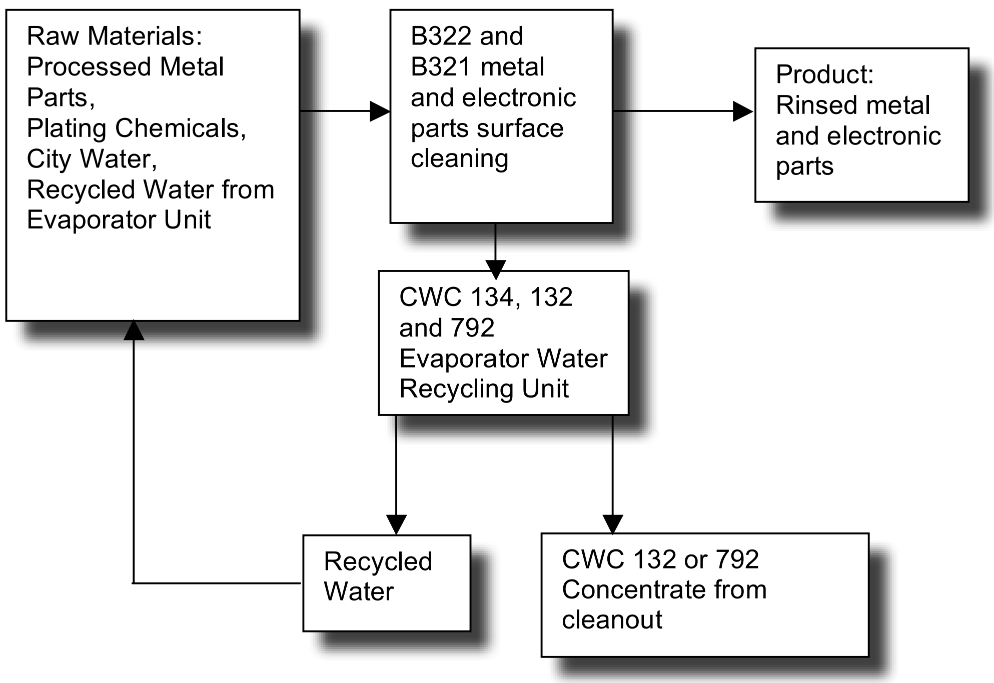

FIGURE 4. CWC 134 PLATING SHOP FLOW DIAGRAM FOR RECYCLABLE RINSE WATER PROCESS

Water used for rinsing processed parts in the B322 and B321 plating shops is typically contaminated with organic chemicals and hazardous metals used in plating operations. While the shops employ pollution prevention measures to minimize wastewater generation during rinsing operations (see discussion under CWC 132- Plating Shop Operations) this is one of the largest hazardous waste streams at LLNL.

The wastewater generated from this process is recycled using an evaporator unit, hard-plumbed into the B322 shop's rinse water system. Water processed in the evaporator is then reused as rinse water in the shop. In addition, the evaporator unit is employed to recycle wastewater from the B321 plating shop (approximately 500 gal/month). The rinse water from B321 is also reused in B322 rinse water processes.

The recycling unit has been processing approximately 13,300 gallons of rinse water per month that would otherwise have to be managed as hazardous waste. Building 322 personnel are optimizing the run time between evaporator sump clean-out operations. Currently, when about 50,000 gallons of wastewater is processed, the evaporator sump is emptied and cleaned. Use of the evaporator process achieves greater than 99% reduction of waste to be disposed of.

SOURCE REDUCTION/POLLUTION PREVENTION EVALUATION
Description of Measure: LLNL plans to continue with current source reduction measures using the evaporator to recycle rinse water back to the plating shop. No other source reduction measures are planned at this time.

Industrial Machines Operations

Site	2006 quantity (lb)
LLNL	10,829

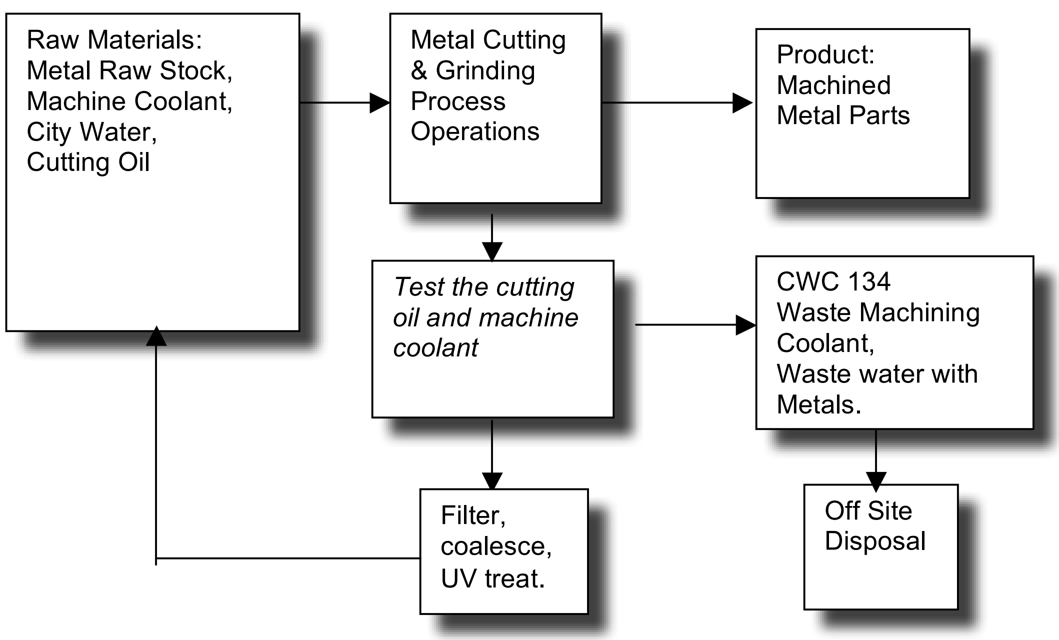

FIGURE 5. CWC 134 PROCESS FLOW DIAGRAM FOR INDUSTRIAL MACHINES OPERATIONS

The major source for this waste stream is metal machining, cutting and grinding operations (similar to CWC 132). The engineering machine shops operate the machines in the B321/B231 where approximately 61% of the total waste stream (10,829 lbs) was generated. This component of the waste stream contains machining coolant and water, with small amounts of tramp oil from the machining and grinding equipment. The remainder of the waste stream was composed of miscellaneous aqueous solutions generated from various optics and polishing operations in machine shops.

The B321 machine shop has implemented several waste reduction measures for (as discussed in CWC 132), including the use of a small point-of-use filtering/tramp-oil coalescing/UV-sterilization coolant recycling unit, and improved management (testing and replenishing) of coolants. As previously noted, the recycling unit had some operational problems in 2006 and repairs are expected in the near future.

SOURCE REDUCTION/POLLUTION PREVENTION EVALUATION
Description of Measure: LLNL plans to continue the existing source reduction measures and best management practices. No other source reduction measures are planned at this time.

Floor Stripping Waste

Site	2006 quantity (lb)
LLNL	22,384

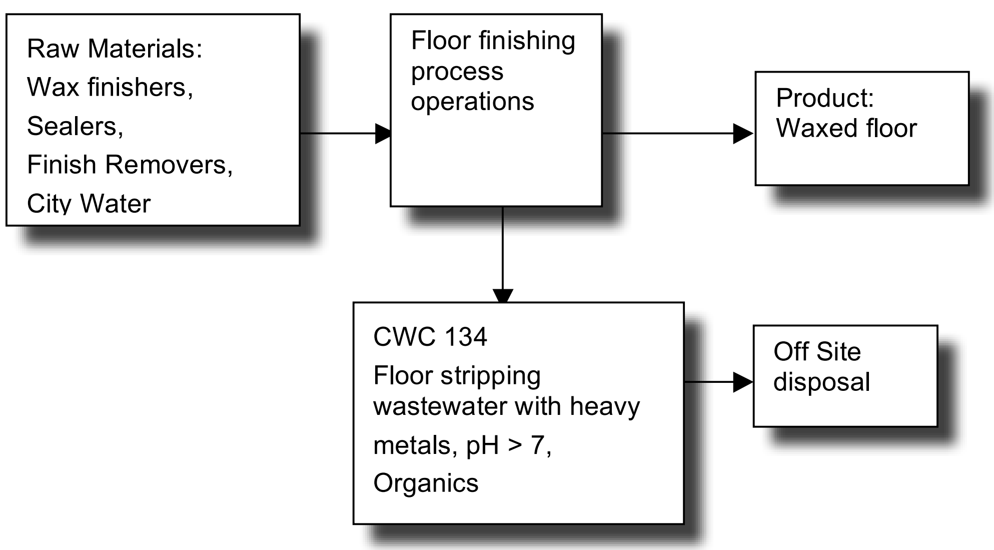

FIGURE 6. CWC 134 PLANT ENGINEERING MAINTENANCE PROCESS FLOW DIAGRAM FOR FLOOR STRIPPING WAX OPERATION.

Many buildings throughout LLNL's main site have asphalt, thermoplastic, polyvinyl chloride (PVC), or vinyl asbestos tile floors that require periodic waxing. The life of the floor can be extended nearly indefinitely with a maintenance program that is consistent with the traffic/dirt load. Plant Engineering maintenance personnel wax all tiled floors annually unless a program requests more frequent maintenance. They use commercial finishers, sealers, and finish removers for floor finishing operations. Floor finishes (waxes) provide an attractive, clear, protective, and removable layer over the floor surface. The finish remover is an alkaline product with organic amines that re-emulsifies the dried floor wax.

Aqueous waste from floor stripping is characterized as hazardous until it is analyzed for contaminants. Analysis shows that this waste stream, which originates from areas other than Radioactive Materials Management Areas (RMMAs), is frequently contaminated with heavy metals or organics, possesses a high pH, or has some combination of these characteristics.

Floor stripping wastes often contain organic contaminants such as amines and glycol ethers. The stripped waxes are sources for some of the organics, although there may be other sources as well, such as chemicals that were spilled on the floors.

When the waste stream contains organics, but not hazardous levels of metals, it is classified under CWC 134, Aqueous Solution with Total Organic Residues <10%. When hazardous levels of metals (such as, zinc) are detected in the waste stream, then it is classified under CWC 132, Aqueous Solution with Metals.

In both a pollution prevention and worker health and safety measure, the team that carries out floor maintenance and floor stripping operations routinely tries alternative stripping products (greener chemicals), such as products that do not contain zinc. To date, alternative products have been found to possess inferior performance, and have not become the standard.

Another factor that has contributed to the reduced quantity of this waste generated between 2002 and 2006 is a shifting of procedures. Routine and annual floor cleanings are now more likely to consist of a scrubbing and burnishing process, reducing the frequency of floor stripping.

SOURCE REDUCTION/POLLUTION PREVENTION EVALUATION
<u>Description of Measure:</u> LLNL plans to continue the existing source reduction measures and best management practices.

Organic Liquid from Oil/Water Separator for Fleet Maintenance

Site	2006 quantity (lb)
LLNL	12,450

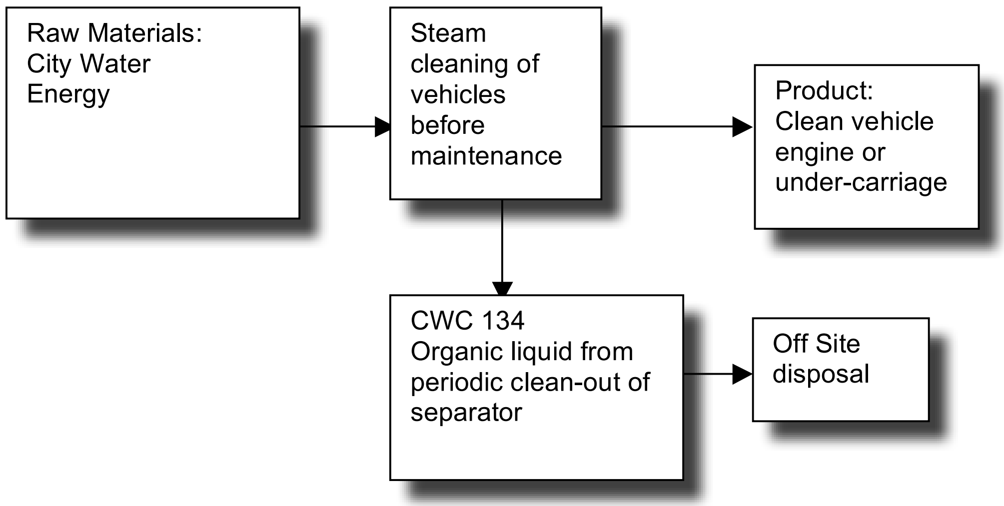

FIGURE 7. CWC 134 FLEET MAINTENANCE PROCESS FLOW DIAGRAM FOR STEAM CLEANING.

This waste is generated when sludge is removed from the oil/water separator at the Fleet Maintenance building. Input to the oil/water separator comes from the carwash and steam cleaner. The separator is pumped out once every other year. There are no operational needs to increase the frequency of pump out, so this waste stream is expected to remain fairly constant. Use of the steam cleaner to remove excess soils (oils, greases, particulate) from an engine prior to servicing, may in itself be a pollution prevention measure, decreasing the use of solvents, or decreasing the soils loading on aqueous parts cleaners in the shop.)

SOURCE REDUCTION/POLLUTION PREVENTION EVALUATION
<u>Description of Measure:</u> LLNL plans to continue the existing source reduction measures and best management practices. No other source reduction measures are planned at this time.

Ground Water Treatment Unit Scale Removal Operations

Site	2006 quantity (lb)
LLNL	1,566

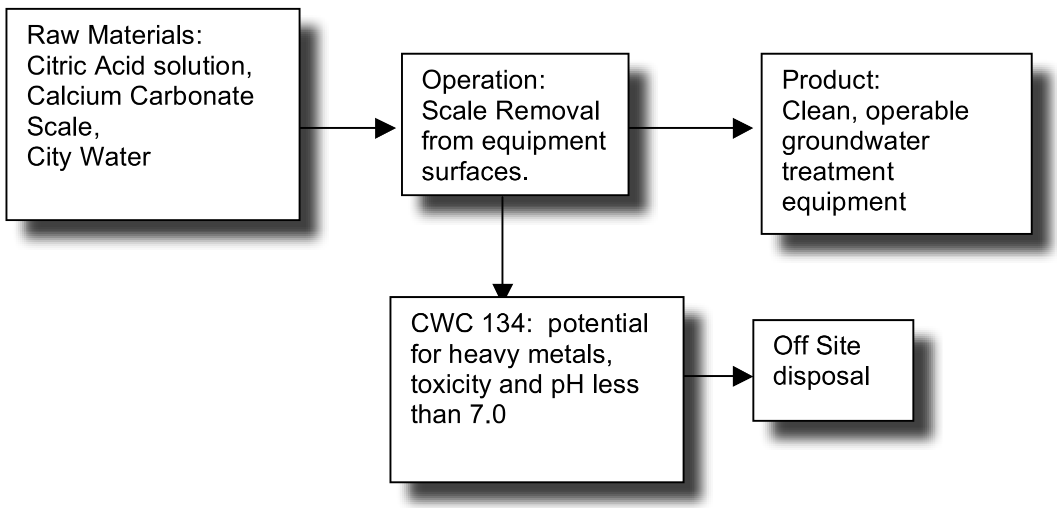

FIGURE 8. CWC 134 ENVIRONMENTAL RESTORATION PROCESS FLOW DIAGRAM FOR GROUND WATER TREATMENT UNIT SCALE REMOVAL OPERATIONS

Environmental Restoration Division's technicians remove calcium carbonate scale from groundwater treatment unit (GTU) surfaces that come into contact with groundwater on an as-needed basis. Four permanent GTU facilities and 24 portable treatment units are monitored during operations and routinely serviced. As calcium carbonate scale builds up on equipment piping, pump impellers and other surfaces, operational efficiency drops off. When a pressure drop is measured, the scale is removed by one of two methods: 1) mechanical abrasion and chipping of scale from equipment surfaces, or 2) flushing a solution of citric acid through the equipment. Some surfaces such as piping and manifolds are not accessible to mechanical removal methods and can only be de-scaled using the citric acid flushing method.

The cleaning solution is constituted by mixing citric acid powder in approximately 40 gallons of city water inside the stainless steel air column tank. The system is then closed and the citric acid solution is pumped through the GTU until the scale is dissolved or mechanically washed from the surfaces. The used citric acid solution is then pumped into a drum and tested for pH and total dissolved solids. If within a predetermined range, the solution is held for use on another GTU. If out of range, the solution is managed as hazardous waste.

In one recently successful measure to reduce scale formation, the environmental restoration team has implemented use of a commercial product, Belsperse 161, an inert surfactant that carries minerals through the GTU system.

SOURCE REDUCTION/POLLUTION PREVENTION EVALUATION
Description of Measure: LLNL will continue the existing source reduction measures, including physical removal (scraping) of scale, using the inert surfactant where possible and cost-effective, and maintaining best management practices.

CWC 181: Other Inorganic Solid Waste

Site	2006 quantity (lb)
LLNL	30,626

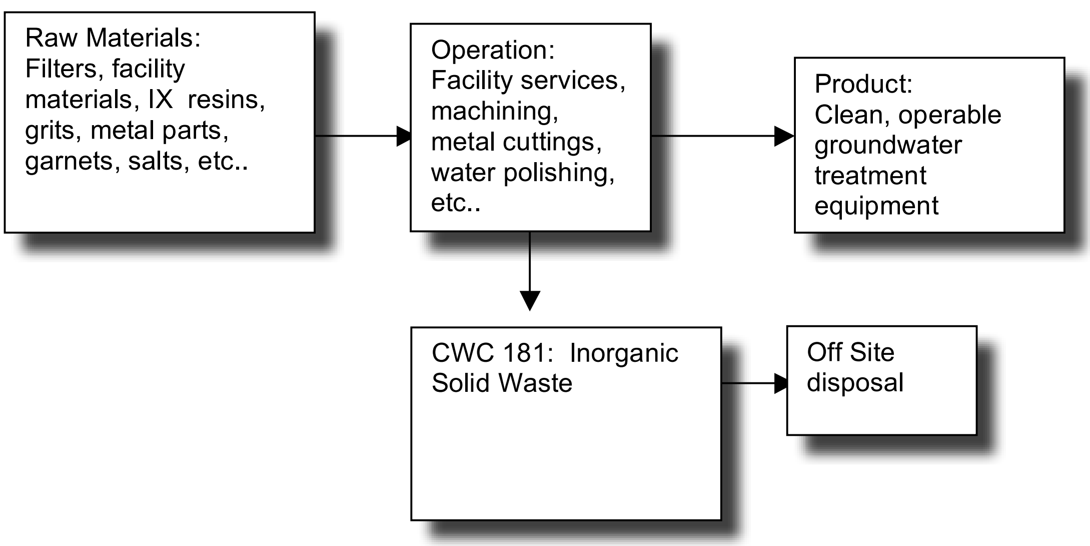

FIGURE 9. CWC 181 ENVIRONMENTAL RESTORATION PROCESS FLOW DIAGRAM FOR GROUND WATER TREATMENT UNIT SCALE REMOVAL OPERATIONS

Laboratory services operations generated a variety of inorganic solid wastes including filters, hoses, spent ion exchange resins, sandblasting grits, small batteries, and cables from various facility service operations. These types of items contributed approximately 51% of the total of CWC 181 wastes.

The small battery waste stream includes alkaline, nickel-cadmium, lithium and carbon-zinc batteries collected through the LLNL Battery Shop. For part of 2006 batteries were shipped out as hazardous waste. A new contract has been set up and batteries collected by the Battery Shop, now go to an offsite vendor. They are labeled as universal waste and the Laboratory takes credit for recycling.

The engineering facilities and shops are responsible for approximately 27% of the CWC 181 waste stream. Various operations in the B321/B231/B153/B131 generated wastes consisting of contaminated metal grindings from parts machining operations, laboratory debris from metal cutting and cleaning, used filters, certain spent water jet garnets, inorganic salts, and other contaminated materials. (Note that while most of LLNL's spent water jet garnets were managed as non-hazardous, those contributing to this waste stream contain zinc.)

The remaining 22% of the total CWC 181 waste stream was generated from numerous miscellaneous operations throughout LLNL.

The wastes within the CWC 181 category came from many different locations and dissimilar processes. For this reason, it is not practically or economically feasible to implement source reduction measures for every process that generates a portion of this waste stream.

Description of Measure: LLNL plans to continue applicable existing best management practices, and raise the awareness of employees of laboratory services and engineering shops to minimize specific components of this waste stream. No other source reduction measures are planned at this point.

CWC 221: Waste Oil and Mixed Oil

Site	2006 quantity (lb)
LLNL	34,644

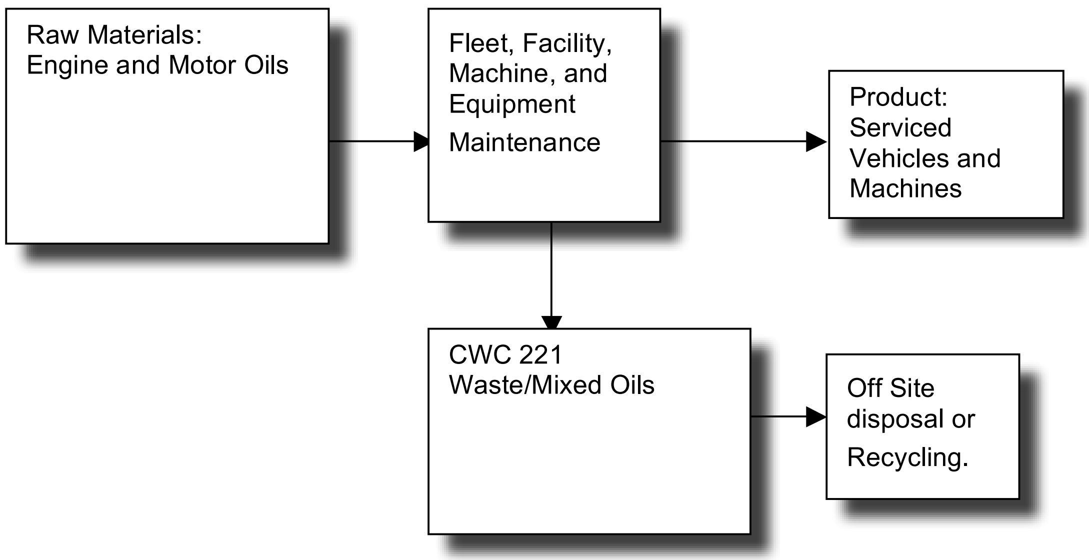

FIGURE 10. CWC 121 PROCESS FLOW DIAGRAM FOR THE FLEET AND MACHINE MAINTENANCE.

The quantity of this waste stream generated at LLNL in 2006 was approximately the same as that in 2002, however, it did not qualify as a major waste stream in the 2003 SB14 report.

Laboratory services operations generated approximately 63% of the total waste oils from fleet and facility (electrical and mechanical equipments) maintenance operations. There are three different vehicle and heavy equipment maintenance locations. The location with the largest generation collects oil in a 1000-gallon tank, which is periodically pumped out and the oil is sent for recycling. The two smaller generation sites collect their oil in drums, which are then managed through an off-site handler for recycling.

Engineering shop operations (mainly from B321/B423) generated approximately 22% of this waste stream in 2006 during routine machine and equipment maintenance. The rest of this waste stream (approximately 15%) was generated from various equipment or facility maintenance operations.

Description of Measure:
LLNL plans to continue existing best management practices and continue offsite waste oil recycling. No other source reduction measures are planned at this point.

CWC 223 Wastes – Unspecified Oil Containing Waste

Site	2006 quantity (lb)
LLNL	27,573

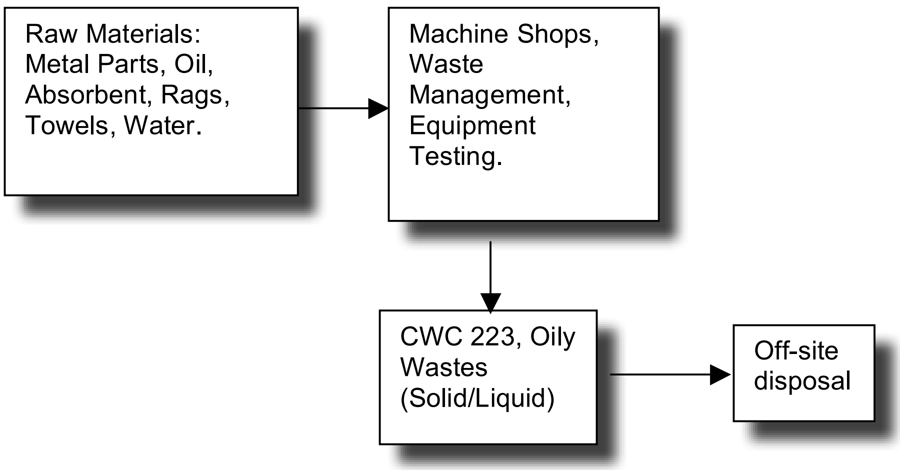

FIGURE 11. CWC 223 ROUTINE OILY WASTE GENERATION PROCESS

This waste stream has a solid component (oily rags and towels from routine cleanup of equipment and tools) and a liquid component (oily water from equipment cleaning). Major processes generating this waste occur in the engineering machine shops (approximately 8%), hazardous waste management facility (approximately 9%), and defense testing facilities at Site 300 (approximately 67%). The remainder of the waste stream was generated from multiple miscellaneous operations in LLNL.

One of waste reduction measure, implemented by several engineering machine shops, is an oily rags recycling program, in place now for several years.

Wastewater contaminated with 1-2% dielectric oil, generated as part of the normal operations and maintenance of a large flash x-ray unit at a Site 300 test facility, is the major source (near 2/3) of this waste stream. The oily wastewater flows into a 500-gallon underground steel "sump" tank, which is automatically pumped into an above ground 300-gallon plastic tank. From this tank, the oily wastewater is transferred to another adjacent 300-gallon plastic tank. The oily wastewater is then pumped into a tanker and is transported to a permitted hazardous waste treatment facility.

The quantity of oily wastewater generated during a given year varies significantly depending on the amount of maintenance work performed on the equipment. The amount of waste generated in CY2006 was substantially higher than it had been in over five years.

SOURCE REDUCTION/POLLUTION PREVENTION EVALUATION
Description of Measure A future pollution prevention measure currently being considered is installation and use of an oil-water separator as part of this operation. The current vision is recycle the water back into the facility cleaning operations. Additionally, the approximately 50 gallons of dielectric oil recovered from the water each year would be cleaned and reused in operations. The cost of an oil-water separator could be as high as $25K and the installation would be approximately $30K.
Technical, Economic, Administrative Considerations Expected Change in Hazardous Waste Generation: If implemented as envisioned, this waste stream would be almost completely eliminated. Technical Feasibility: Medium to High Economic Feasibility: Low because return-on-investment (ROI) funding is no longer available Effects on Product Quality: NA Employee Health and Safety: There are no additional risks to employees Regulatory Issues: None Releases and Discharges: No routine discharges or releases
Evaluation of Effect of Measure on Media (Land, Water, and Air) - Low or no impacts on media.
Schedule for Implementation Depends on funding availability.

CWC 352 Wastes - Other Organic Solid

Site	2006 quantity (lb)
LLNL	22,663

Chemical, material, and life science research activities contributed approximately 33% of this CWC 352 waste stream. A one-time lab pack cleanout event in B191 was a major source. The remainder is comprised of various wastes related to explosives testing, with contaminated water-soaked sawdust as the largest single source. Small quantities of waste generated from numerous explosives test related activities makes further waste minimization impractical.

Laboratory services operations contributed approximately 29% of the total CWC 352 wastes. Spent ion exchange resins generated during polishing of deionized water constituted the majority of the waste stream (approximately 2/3). Annual generation of this waste stream is expected to decline as compared to 2006 due to modified management strategies. An additional step that is/will be used when available is the take-back of the resins for regeneration by the vendor. Vendor defined parameters dictate whether this is an option.

The remainder of CWC 352 wastes were generated from various operations.

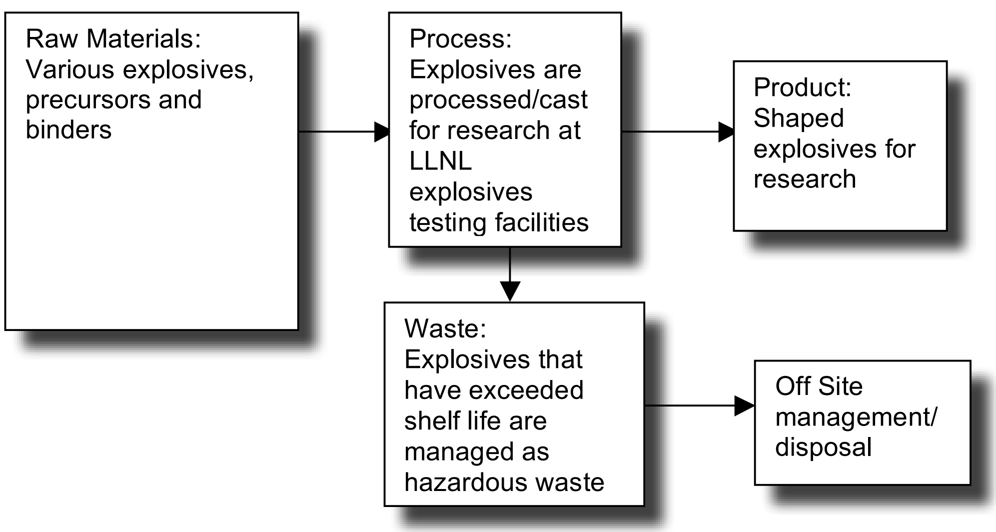

FIGURE 12. CWC 352 EXPLOSIVES INVENTORY MANAGEMENT PROCESS FLOW DIAGRAM

Explosives inventory management waste generated from defense technology projects constitutes about 20% of the LLNL CWC 352 total. Explosives and explosive precursors are processed and cast into different shapes and used in research conducted at LLNL explosives testing facilities.

Physics and applied technology facilities generated approximately 13% of this waste stream. The majority of this component was generated from equipment cleanout (debris).

SOURCE REDUCTION/POLLUTION PREVENTION EVALUATION

Description of Measure LLNL will seek opportunities to minimize waste generated during laboratory cleanout by implementing better chemical management practices, such as encouraging employees to use the existing chemical share system. LLNL will also seek opportunities for stakeholders to minimize the amount of waste generated from explosives exceeding shelf life through improved forecasting of program requirements and inventory planning.
Technical, Economic, Administrative Considerations Expected Change in Hazardous Waste Generation: If implemented as envisioned, this waste stream could be reduced. Technical Feasibility: Medium (needs to be integrated into the Lab-wide environmental management system) Economic Feasibility: Medium Effects on Product Quality: None Employee Health and Safety: There are no additional risks to employees Regulatory Issues: None Releases and Discharges: None
Evaluation of Effect of Measure on Media (Land, Water, and Air) Low or no impacts on media.
Schedule for Implementation: To be determined.

CWC 791 - Liquids with pH<2

Site	2006 quantity (lb)
LLNL	24,030

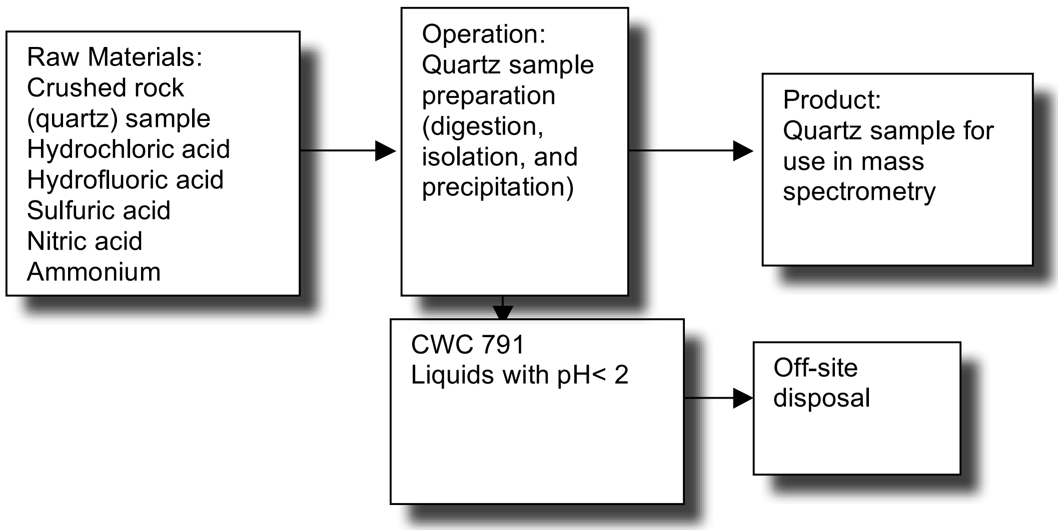

FIGURE 13. CWC 791 FLOW DIAGRAM FOR QUARTZ SAMPLE PREPARATION FOR MASS SPECTROMETRY

Approximately 74% of this acidic waste stream was generated from energy and environmental research activities. Greater than 90% of that was derived from one process for quartz sample preparation (an earth science project). The process utilizes hydrochloric, hydrofluoric, nitric, and sulfuric acids to digest and purify quartz samples for subsequent analysis of carbon-14 and other isotopes at LLNL Center for Accelerator Mass Spectrometry. Waste from this process is managed as hazardous waste. While the waste quantities generated by this process in 2002 and 2006 were almost identical, annual generation fluctuates based on scientific mission, and this waste stream was considerably smaller in the years between SB14 reports.

SOURCE REDUCTION/POLLUTION PREVENTION EVALUATION
Description of Measure The scientific mission of this earth science research project in a given year influences the number of samples digested on-site and the resultant waste generated. Two source reduction measures have been explored by this research team: 1) There is a recent trend for quartz samples to be prepared off-site which has the potential to decrease this waste stream. 2) In some circumstances, increased sensitivity of the detection equipment has allowed for smaller quartz samples to be used for the process, requiring less acid for preparation per sample. One alternative waste management measure was considered, the installation of a benchtop treatment system within the laboratory. This possibility was ruled out based on complications with the physical parameters of the lab, and uncertainty with the future of this project.
Technical, Economic, Administrative Considerations Expected Change in Hazardous Waste Generation: This waste stream could be reduced depends on if quartz samples could be prepared off-site or the detection sensibility of equipment could be increased. Technical Feasibility: Medium Economic Feasibility: Medium Effects on Product Quality: None Employee Health and Safety: None Regulatory Issues: None Releases and Discharges: None
Evaluation of Effect of Measure on Media (Land, Water, and Air) Low or no impacts on media.
Schedule for Implementation: To be determined

Another 12% of this CWC 791 waste stream came from optics etching operations in B298 and B392. The process uses a small amount of an acid for etching, which is then drained off into a 5-gallon carboy for disposal. Successive rinses (non-hazardous) of the etched optics are pH neutralized and disposed of to sewer. This process is already optimized for minimal hazardous waste generation.

Category C Wastes – Extremely Hazardous

CWC 134

Site	2006 quantity (lb)
LLNL	44

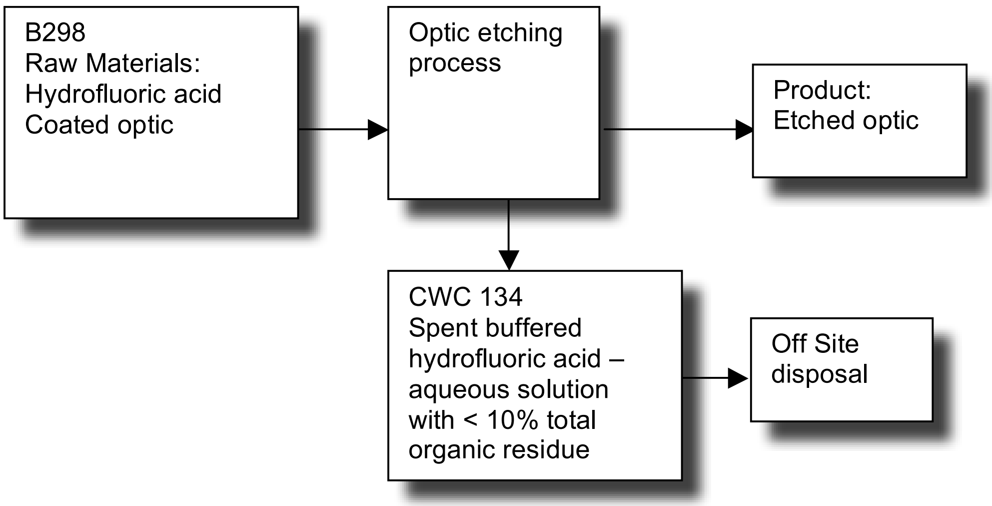

FIGURE 14. CWC134 EXTREMELY HAZARDOUS WASTE PROCESS FLOW DIAGRAM

The majority of this waste is spent, buffered, hydrofluoric acid (HF) generated in B298, used to etch a diffraction grating pattern on glass optics.

SOURCE REDUCTION/POLLUTION PREVENTION EVALUATION
Description of Measure: LLNL plans to continue existing best management practices to minimize this waste stream. No other source reduction measures are planned at this point.

CWC 135

Site	2006 quantity (lb)
LLNL	342

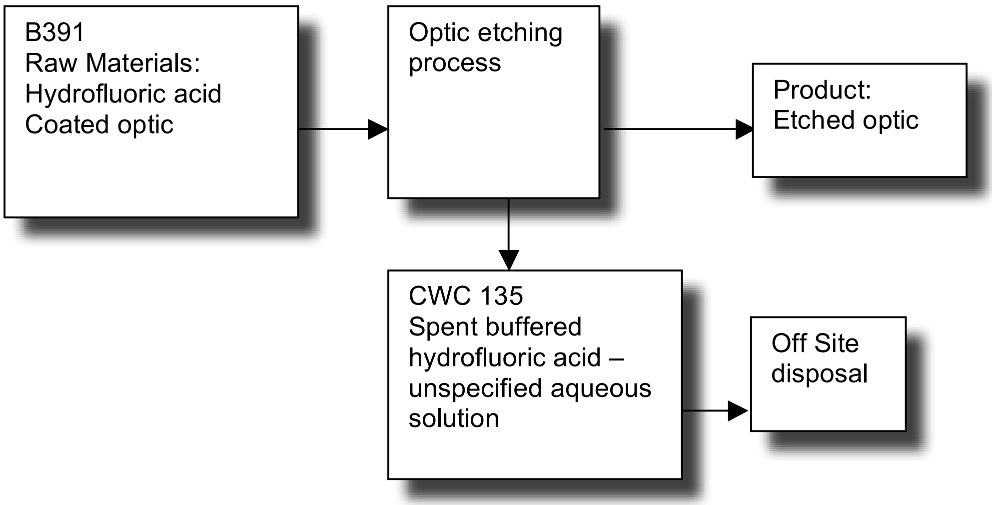

FIGURE 15. CWC135 EXTREMELY HAZARDOUS WASTE PROCESS FLOW DIAGRAM

The majority of this was from spent, buffered, hydrofluoric acid (HF) used for bulk bath optics etching in B391. The bath consisted of approximately 10 gallons concentrated HF and 20 gallons of rinse water. Every few months (after approximately 20 optics sets), when the solution was no longer usable, it was removed and disposed of as hazardous waste. An improved process was installed in late 2006, replacing the larger bulk bath with a 2-gallon reservoir, which is changed one or two times per year. This should significantly decrease the amount of hazardous waste generated from the etching process.

SOURCE REDUCTION/POLLUTION PREVENTION EVALUATION
Description of Measure: LLNL will continue the source reduction effort to use a smaller acid reservoir and change the solution less frequently.

CWC 181: Other Inorganic Solid

Site	2006 quantity (lb)
LLNL	75

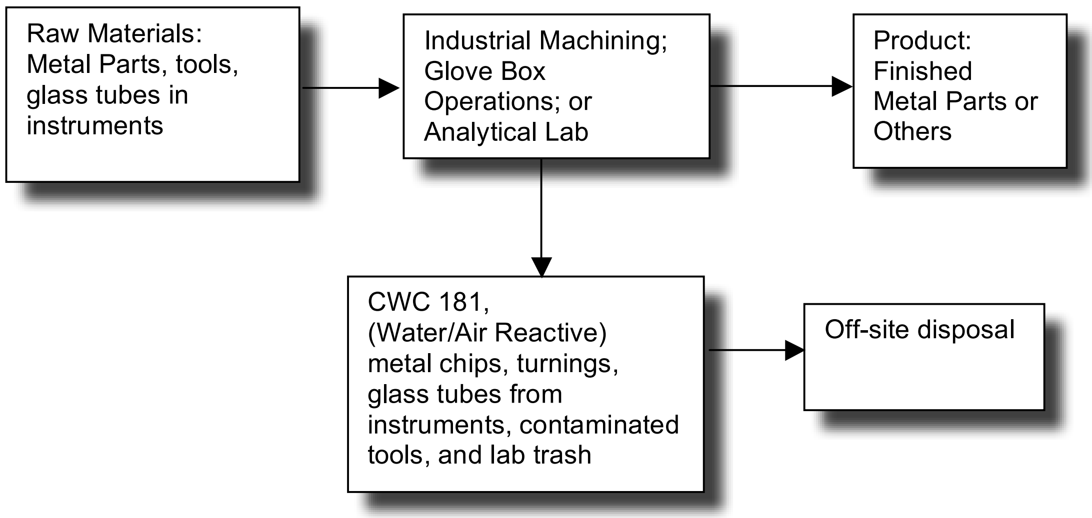

FIGURE 16. CWC181 EXTREMELY HAZARDOUS WASTE PROCESS FLOW DIAGRAM

Chemistry, materials, and life science research activities in B361 contribute 24 lbs of this waste stream, generated by the disposal of spent glass tubes. The tubes, used in the Accelerator Mass Spectrometer (AMS), contained titanium hydride and zinc powders. Spent tubes were packed in mineral oil prior to disposal. Another 6 lbs of this waste stream were generated from two unrelated operations.

The engineering machine shops in the B321/B231 generated approximately 43 lbs of this waste stream, consisting of metal chips (cerium) from parts machining operations and contaminated tools (containing cerium) generated from an out-of-service glove box (B231).

Description of Measure:
LLNL plans to continue existing best management practices to minimize this waste stream. No other source reduction measures are planned at this point.

CWC 352: Other Organic Solid

Site	2006 quantity (lb)
LLNL	41

B191 generated 33 lbs of this waste stream during a one-time laboratory cleanout activity. This legacy waste consists of several small items containing tetramethylammonium borohydride and lithium hydroxide. Another 8 lbs of this waste stream was the lab trash (contaminated with 1,2,3,4-diepoxybutane) generated from B364. This is also a one-time waste.

Description of Measure:

LLNL plans to continue existing best management practices to minimize this waste stream. No other source reduction measures are planned at this point.

CWC 791: Liquid with pH < 2

Site	2006 quantity (lb)
LLNL	228

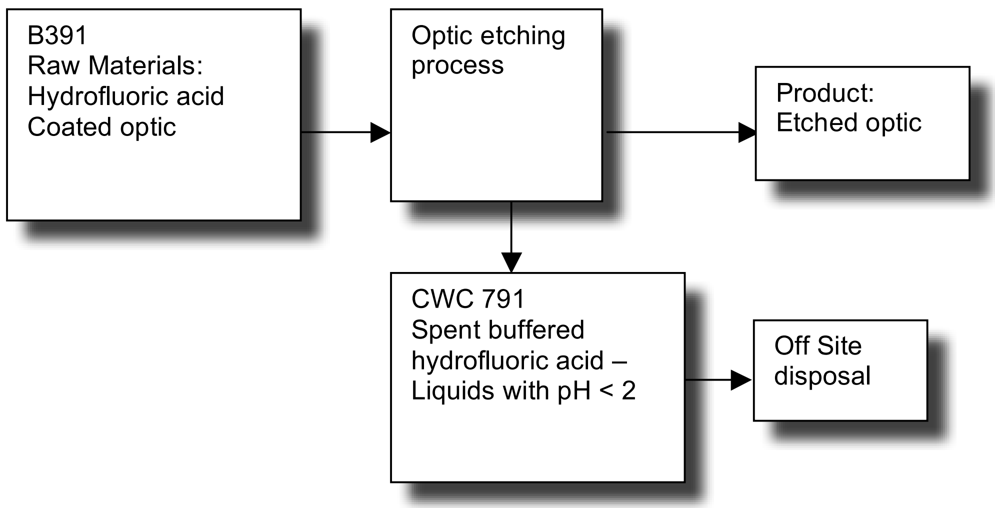

FIGURE 17. CWC 791 EXTREMELY HAZARDOUS WASTE PROCESS FLOW DIAGRAM

The LLNL CWC 791 waste stream was generated by several different operations including optics etching activities in B391 (approximately 44% of total), silicone etching operations in B153 (approximately 21% of total), and germanium etching in the T2801 semiconductor laboratory (approximately 21% of total.) (Note that the semiconductor laboratory was closed down and is no longer performing the etching operations). The remainder of the CWC 791 waste stream was generated from several cleaning and etching activities in different buildings.

The majority of this waste stream was spent buffered hydrofluoric acid generated in B391 (see the above diagram), used for bulk bath optics etching. The bath consisted of approximately 10 gallons concentrated HF and 20 gallons of rinse water. Every few months (after approximately 20 optics sets), when the solution was no longer usable, it was removed and disposed of as hazardous waste. An improved process was installed in late 2006, replacing the larger bulk bath with a 2-gallon reservoir which is changed one or two times per year. This should significantly decrease the amount of hazardous waste generated from the etching process.

Silicone Wafer Etching and Cleaning

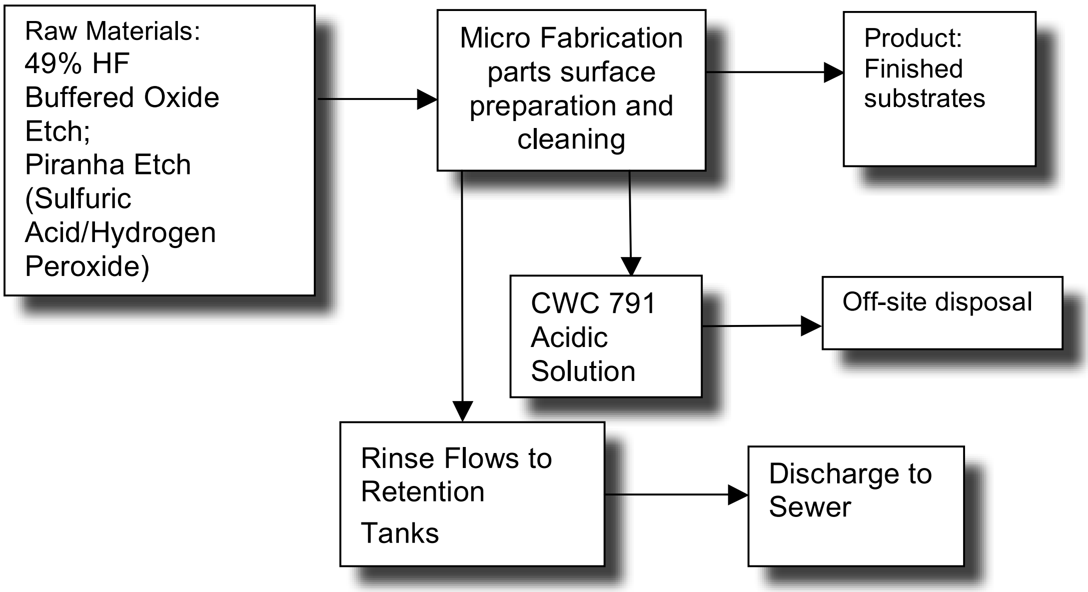

FIGURE 18. CWC 791 B153 EXTREMELY HAZARDOUS WASTE PROCESS FLOW DIAGRAM

B153 has two sources of liquid waste with a pH < 2. (1) HF solutions are used primarily to etch SiO_2 as a preparation for applying additional materials to the top of silicone wafers. The extremely hazardous waste is always disposed of in 2-liter bottles. (2) Sulfuric acid blends such as Piranha etch are used for surface preparation of substrates and are disposed of in 5-gallon carboys and 30-gallon drums.

After surface preparation, substrates are rinsed with water. The rinsewater, which is non-hazardous, flows into retention tanks. After pH adjustment when necessary, it is discharged to the sewer. This discharge is monitored by LLNL's water monitoring specialists.

B153 has already optimized their etching and surface cleaning processes and can find no other source reduction measures to reduce current waste generation rates. B153 is going through a growth cycle in which the users of our facilities are increasing, resulting in the potential for increasing waste volumes.

SOURCE REDUCTION/POLLUTION PREVENTION EVALUATION
Description of Measure: LLNL plans to continue existing best management practices to minimize this waste stream. No other source reduction measures are planned at this point.

SB14 Source Reduction Report
Category B Wastes

CWC 132: Aqueous Solution With Metals

Site	2002 quantity (lb)	2006 quantity (lb)
LLNL	55,835	32,985

Ion Exchange Bed Regeneration, Groundwater Treatment Unit

Site	2002 quantity (lb)	2006 quantity (lb)
LLNL	4170	0

In 2006, the spent resin beds from groundwater treatment units were sent back to the vendor for regeneration. There were no on-site resin regeneration activities performed by environmental restoration team.

Industrial Machines Operations

Site	2002 quantity (lb)	2006 quantity (lb)
LLNL	15,183	16,350

A major source for this waste stream is metal machining, cutting and grinding operations in B321/B131. This waste stream contains metal cuttings from machined parts, machining coolant and water, with small amounts of tramp oil from the machining and grinding equipment.

Several waste reduction measures for the B321 machine shop have been taken, including the use of existing small point-of-use filtering/tramp-oil coalescing/UV-sterilization coolant recycling units and improved management methods (testing and replenishing) for coolants. These units were in use prior to 2003. The minor increase of this waste stream in 2006 is within the normal variation in the past years and is likely due to the malfunction of some of these recycling units in 2006.

The LLNL P2 Team has also made arrangements to provide waste generation data to the shop foremen so that they can track the effectiveness of their waste minimization efforts.

B321A/B322 Plating Shops Operations

Site	2002 quantity (lb)	2006 quantity (lb)
LLNL	17,931	13,813

Because of the research nature of the operations, B321A/B322 plating activities can generate different types of rinse-water and spent plating solutions.

The rinsewater generated from those plating processes is almost completely recycled using an evaporator unit at B322. The recovered water is all reused in B322 plating shop. However, the periodic cleanout of evaporator's concentrate still generates some aqueous wastes.

The plating shops also continue source reduction measures to extend the life of the baths by using spray rinsing, minimizing drag out, and other methods to reduce contaminating the plating baths. However, once these baths are spent and no longer meet the specifications, the solutions are containerized and shipped off-site for treatment and disposal at authorized facilities.

Building 321 water condensate collection from air conditioner

Site	2002 quantity (lb)	2006 quantity (lb)
LLNL	11,134	0

In 2002, the condensate water from air conditioner units at the top of Building 321 contained low levels of copper due to leaching of the cooling coils. The water was collected and sent off site for treatment and disposal.

This waste stream has since been eliminated because the air conditioner units have been replaced and the condensate water from the new units is no longer hazardous.

CWC 134: Aqueous Solution With Total Organic Residues Less Than 10 Percent

Site	2002 quantity (lb)	2006 quantity (lb)
LLNL	681,602	1,396,888

B322 Plating Shop Rinse water Recycling

Site	2002 quantity (lb)	2006 quantity (lb)
LLNL	600,480	1,344,102

Water used for rinsing processed parts in the B322 and B321 plating shops is typically contaminated with organic chemicals and heavy metals used in plating operations.

The wastewater generated from this process is recycled using an evaporator unit at B322. In addition, the evaporator unit is also employed to recycle wastewater from the B321 plating shop (approximately 500 gal/month). The rinse water from B321 is reused in B322. The evaporator process results in 99% less waste to be disposed of.

The B321 machine shop has also taken several waste reduction measures (similar as CWC 132), including the use of existing small point-of-use filtering/tramp-oil coalescing/UV-sterilization coolant recycling units and improved management methods (testing and replenishing) of coolants.

The increase of rinsewater recycled at B322 was mainly because of a workload increase at both B321 and B322 in 2006.

Floor Stripping Waste

Site	2002 quantity (lb)	2006 quantity (lb)
LLNL	39,978	22,384

In both a pollution prevention and worker health and safety measure, the team that carries out floor maintenance and floor stripping operations routinely tries alternative stripping products, such as products that do not contain zinc. To date, alternative products have been found to possess inferior performance, and have not become the standard.

The major factor that has contributed to the reduced quantity (40% reduction) of this waste generated between 2002 and 2006 is a shifting of procedures. Routine and annual floor cleanings are now more likely to consist of a scrubbing and burnishing process, reducing the frequency of floor stripping. In the past four years, this waste stream was characterized as hazardous primarily because its zinc level exceeds the sewer discharge limit, based on sampling results.

Ground Water Treatment Unit Scale Removal Operations

Site	2002 quantity (lb)	2006 quantity (lb)
LLNL	2,619	1,566

Environmental restoration field technicians remove calcium carbonate scale from groundwater treatment unit (GTU) with one of two methods: 1) Mechanical abrasion and chipping of scale from equipment surfaces, or 2) Flushing a solution of citric acid through the equipment.

The cleaning solution is constituted by mixing citric acid powder in approximately 40 gallons of city water inside the stainless steel air column tank. As one of the waste minimization measures applied to this process, the used citric acid solution is pumped into a drum and tested for pH and total dissolved solids. If within a predetermined range the solution is held for use on another GTU.

The environmental restoration team has also implemented use of a commercial product, Belsperse 161, an inert surfactant that carries minerals through the GTU system, resulting in reduced scale formation.

<u>CWC 792: Liquids with pH<or=2 with metals</u>

Site	2002 quantity (lb)	2006 quantity (lb)
LLNL	85,954	12,036

B231/B321A/B322 Plating and Etching Operations

Site	2002 quantity (lb)	2006 quantity (lb)
LLNL	79,728	9,878

The engineering plating and etching shops process metal parts based on strict customers' specifications. As part of this process, different acidic solutions are used. Once these acidic plating or etching baths can no longer meet specifications, the solutions are containerized and shipped off-site for treatment and disposal at authorized facilities. The waste stream generated in 2006 (9,859 lbs) primarily consisted of spent or discarded plating, etching, or stripping solutions.

In 2002, approximately 95% of this waste stream was acidic rinse water. However, in 2006, almost all of rinse water generated from engineering plating shops (B321/B322) was recycled using the existing evaporator at B322.

B322 Plating Shop UBAC Copper Plating Waste

Site	2002 quantity (lb)	2006 quantity (lb)
LLNL	3,753	0

The B322 plating shop employs number of different processes to serve the need for the research and development activities at LLNL site. Udylite Bright Acid Copper (UBAC) surface finishing process is one of them. The B322 plating shop processes parts according to strict customers' needs and requirements. The generation rate of spent plating bath solutions depends on how many requests the plating shop receives for this process. In 2006, no acidic waste was generated from this UBAC surface finishing process.

Category C Wastes – Extremely Hazardous

CWC 213: Hydrocarbon Solvents

Site	2002 quantity (lb)
LLNL	284

KDP crystal cleaning operations

Site	2002 quantity (lb)	2006 quantity (lb)
LLNL	284	0

The waste stream generated in 2002 primarily consists of toluene. Toluene is used as a cleaner in the potassium dihydrogen phosphate (KDP) crystal process development, and in the processing of the beamlet crystals at B391. The spent toluene is managed as a hazardous waste and it is disposed off-site.

The KDP crystal cleaning system continues to function well. During CY2006, the spent cleaning agent containing toluene and other solvents was characterized as CWC 214 mixed solvent waste and was not extremely hazardous.

CWC 792: Liquids with pH<or=2 with metals

Site	2002 quantity (lb)	2006 quantity (lb)
LLNL	1,420	5

B322 Plating Shop Spent Inorganic Etchant

Site	2002 quantity (lb)	2006 quantity (lb)
LLNL	1,251	0

The B322 plating shop processes metal parts based on strict customers' specifications. As part of this process, different acidic solutions are used. Once these acidic baths no longer meet specifications, the solutions are containerized and shipped off-site for treatment and disposal at authorized facilities. This waste stream primarily contains acids and metals, depending on the type of metal parts that are processed. In 2006, this waste stream was characterized as hazardous in Category B rather than extremely hazardous in Category C due to a change in characteristics.