COMPOST CONNECTIONS

VACANT LOTS SPROUT URBAN FARMS

The Food Project converted several vacant parcels (above, left) into highly productive urban farms. Its Build-A-Garden program, launched in 2007, provides a raised bed "kit" that includes a frame, fabric to lay down on top of the soil, plants and compost (above, middle and right).

Hunger, obesity, lack of access to fresh produce, unemployment and vacant lots — many contaminated and void of organic matter — are driving an exciting urban agriculture movement.

Nora Goldstein

CLEVELAND, Ohio has approximately 3,300 acres of vacant land within its city limits, and an estimated 15,000 vacant buildings. This includes sites designated as brownfields by the U.S. Environmental Protection Agency. The population of Cleveland has declined from about 506,000 in 1990 to 438,000 in 2007. By 2016, the city's population is projected to drop to about 387,000 people.

Instead of being overwhelmed by this dismal landscape, there is a visible spirit of determination to revitalize Cleveland, lot by lot, acre by acre. In 2008, Neighborhood Progress, Inc. (NPI), in collaboration with the City of Cleveland and Kent State University's Cleveland Urban Design Collaborative, convened a 30-member working group to explore strategies for reuse of vacant land with the goal of making Cleveland a cleaner, healthier and economically sound city. The working group's report, *Re-Imagining A More Sustainable Cleveland*, was adopted by the Cleveland City Planning Commission in December 2008 (available at www.neighborhoodprogress.org).

"We focused on parts of the city outside of the Core Development Area to identify ways to derive measurable benefits from vacant properties in these areas," explains Bobbi Reichtell, Senior Vice-President for Programs at NPI. "The lack of strong market demand and an abundance of vacant land create unprecedented opportunities to improve the city's green space network and natural systems. Agriculture, green infrastructure and other nontraditional land uses will benefit existing residents and help to attract new residents and development."

Many strategies reviewed in *Re-Imagining A More Sustainable Cleveland* relate to restoring soils to support vegetation and assist with storm water management. But the section most relevant to this article discusses how vacant land can yield an economic return via productive landscapes, including agriculture and energy generation. The report includes a map of "food deserts," places where "fast food restaurants are prevalent and grocery stores are few." Community gardens, market gardens and urban farms are emerging throughout the city, encouraged by organizations such as City Fresh and the Cleveland Botanic Garden.

As a follow-up to the report, and to solicit proposals for pilot projects to implement strategies identified, NPI held seven public workshops around Cleveland. Over 100 applications for projects related to urban agriculture, storm water management, vacant lot remediation and more, were received. "We are going to fund 52 of them," says Reichtell, "and are just waiting for the city's final approval before we can announce them."

Without a doubt, compost will be one of the running themes throughout most of the initiatives implemented as part of building a more sustainable Cleveland. For example, the Cleveland Botanical Garden has been evaluating seed mixes that can be used to vegetate vacant lots contaminated with lead. "A few years ago, we planted a no-mow commercial seed mix on vacant lots," says Sandra Albro, Research Manager at the Botanical Garden. "The seed was just thrown right on top of the lots. It was right after houses had been demolished. Three years later, those plots have only about 40 to 60 percent grass coverage and a lot of weeds, including invasive weeds. The recommendation from the grass experts is that the soil needed more

organic matter such as compost."

Compost is also integral to Cleveland's urban farm and community garden programs. "There is nothing more valuable to farmers, whether they are in the country or the city, than compost," says Maurice Small of City Fresh, which runs programs to build a more sustainable food system in Northeast Ohio. "This is especially true in the city, where soils are very poorly supported by organic life."

BROWNFIELD LINKS

The U.S. Environmental Protection Agency defines a brownfield as follows: "Brownfields are real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant." EPA estimates that there are more than 450,000 brownfields in the U.S. Its Brownfield Program, started in 1995, provides grants to support revitalization by funding environmental assessment, cleanup and job training activities. Extensive information about the grants program, case studies, resources and more are on the agency's website (www.epa.gov/ brownfields).

Grant proposal guidelines for next year have been posted. "Governmental entities are eligible to apply for all these types of grant funds so we encourage community organizations to work with their local, county, tribal or state government to apply for grants," says Ann Carroll of EPA's Office of Brownfields & Land Revitalization in Washington, D.C. Nonprofit, 501(c)(3) community based organizations can apply for cleanup grants on sites they already own but a Phase I Environmental Site Assessment has to be conducted before they acquire the property in order to be eligible. "Right now the conversion of brownfields to community gardens and urban farms is really taking off, especially in the Midwest," she adds.

A number of cities in Midwest states are indeed launching brownfield redevelopment programs that involve urban farms and community gardens. These "rustbelt" states have experienced significant loss of manufacturing industries, most recently related to the automotive sector. Concurrent with factory closures is job loss, migration of population (leaving deteriorating housing stock) and overall blight. Last February, U.S. Representative Marcy Kaptur from Toledo, Ohio held a summit, "City in a Garden," to highlight the potential of the Toledo community to address their struggle to feed the increasing number of hungry citizens with growing local food.

"Congresswoman Kaptur pointed out that only two percent of the food consumed by Ohio families is actually grown here," says Katherine Bibish, a staff assistant in the Toledo office. "New statistics show Toledo as being the eighth poorest city in the U.S. in 2008, with about one-quarter of the population living below the poverty line. There has been a 54 percent increase in demand at food pantries in the last year. From Congresswoman Kaptur's perspective, the questions are not only how we combat emergency hunger in our community, but how do we capture food power economically. Our potential solution is people growing their own food. In an urban area, we are a cement jungle, so we want to employ more systems and technologies that allow people in urban areas to grow fresh produce and get quality food, and create jobs with these technologies."

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While Toledo is ripe with brownfields, there has not been one overarching plan to coordinate conversion of some of this land to productive use. "There are over 80 community gardens in Toledo," adds Bibish. "We also have the Center for Innovative Food Technology, which is helping to establish hoop houses to extend the growing season and vertical hydroponic gardens that can be set up on rooftops or parking lots to grow produce. There are all these great little pieces, but not an overarching broad project or vision."

She notes that the potential surrounding urban agriculture is "transformative" for a city like Toledo. "Five years ago, there would not be this much excitement. Now there is a real potential to make progress to combat hunger, create jobs, have local sources of healthy foods and revitalize the city."

THE FOOD PROJECT IN BOSTON

The Food Project (TFP), based in Lincoln, Massachusetts, has a long history of remediating vacant lots with contaminated soils into urban farms and gardens. The complete story is included in TFP's Urban Agriculture Manual, which can be downloaded from the organization's website at no charge (http://thefoodproject.org/manuals). Briefly, Ward Cheney, TFP's founder, "was committed to introducing young people and volunteers from the city and suburbs to healthy organic vegetable production … He saw urban agriculture as a way to redeem neglected land in the city, bridge generations and build community, and create a potential source of income for skilled growers."

Cheney zeroed in on Boston's Dudley neighborhood, a diverse community with a history of activism and a large base of experienced farmers from the American South, the Caribbean, and Cape Verde, Africa. The neighborhood was designated a brownfields area in the 1980s due to severe lead contamination. Cheney also saw a lack of access to food, i.e., no grocery store within walking distance, and unreliable and indirect public transportation, as well as high use of food stamps, soup kitchens and food pantries. In addition, widespread destruction of houses had followed the redlining of the neighborhood by banks and real estate companies in the 1960s and

City Fresh worked with Filtrexx International to install a garden on a vacant lot in Cleveland. Straw bales were used to frame the garden (top). Cardboard was laid down first, and then compost-filled socks were placed on top (middle). Soil was added to fill in around the socks. Food scraps were scattered on top to be tilled into the soil (bottom).

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1970s, leaving over 1,000 vacant lots.

The Food Project collaborated with the Dudley Street Neighborhood Initiative (DSNI) to develop an urban farming program. DSNI, a community organization, was founded in the mid 1980s by residents to combat illegal dumping of slaughterhouse refuse and other waste products in their neighborhood. It had the right of eminent domain over all the land within an area designated as the Dudley Triangle. The first farm was located on a half-acre parcel that had been cleaned of debris and weeds. Notes the manual: "During the summer of 1995, Food Project youth and the newly hired grower, Martha Boyd, spent a week in the city spreading 10 truckloads of compost — more than 300 cubic yards — on top of the contaminated land beneath and writing about the potential for creating a farm in the city. By the summer of 1996, lead tests showed that the land was clean enough to grow on."

Two urban farms were established. Once those had been operating for a couple years, TFP wanted to start working to establish gardens within the community. "The Cape Verdians living in the Dudley Street neighborhood already had gardens, as that is part of their culture," says Kathleen Banfield, TFP's Urban Education & Outreach Coordinator. "They grow on whatever land they have. We knew that the soils had a lot of lead based on old housing stock and lead paint, and we wanted to start working with them on how to improve them."

Experiments were done with phytoremediation on nine home gardens planting mustards and sunflowers. Soil and plant tissue were tested. "We did that for three years, and found that it would take a really long time to get lead out of soils," says Banfield. "We also tried excavating contaminated soil and replacing it, which was a mixed success." Adding compost and tilling it in is another option. TFP gives compost away each year to home gardeners at the City of Boston's Farm Fest, and recommends applying and tilling in 6-inches.

In 2007, TFP launched the raised bed "Build A Garden" program. "We had been doing raised beds for years as an alternative to direct soil planting on contaminated land," she adds. "For some people, raised beds aren't good enough because they can't plant in all the available land. But for many others, raised beds provide people a way to grow their own food." People pay what they can for a Build A Garden, which is a 4-foot by 8-foot raised bed. Landscape fabric is laid down on the soil. Yard trimmings compost from the city of Boston's site is added. Gardeners can plant directly in the compost.

Today, TFP farms a total of roughly 2.5 acres in the city of Boston. It is able to harvest over 20,000 pounds of fruits and vegetables each year.

COMPOST SOCKS FOR URBAN AG

A recently introduced alternative to a traditional raised bed are 2-foot lengths of compost-filled socks that can be laid down directly on cement, asphalt or contaminated soil in vacant lots. The urban agriculture growing system from Filtrexx International uses the same compost sock technology introduced for erosion and sediment control for storm water management. "The socks are filled with half-inch minus yard waste compost," says Rod Tyler, CEO of Filtrexx, based in Grafton, Ohio. "Gardeners and farms plant right into the sock."

A pilot urban garden was installed in Cleveland several years ago using 100-foot long compost filled socks. Working with City Fresh, a layer of cardboard was placed over grass that had been planted on a vacant lot. A layer of topsoil was spread on top of the flattened boxes; the socks were laid down on top of the soil and planted. Straw bales were used to frame the garden. "The garden is at a rehab center and we were asked to create a curved shape versus doing only a square," says Alex Marks of Filtrexx. "We had some extra sock so we laid down a semicircle at the top."

Working with the 100-foot long sections was "a pain in the neck," adds Tyler. "We were searching for an answer that anyone could use, and that is when we came up with the idea of a 2-foot length sock. The roots of the plants don't need more than 8 inches, so we use an 8-inch sock. And the beauty of the system is that if the lot is developed, the socks can be sliced open and the compost spread on the soil, which will assist with remediation."

City Fresh, The Food Project and other organizations contacted for this article (and to be featured in an upcoming issue) all are working models of how to address social, economic and environmental challenges with farms and community gardens. Each program we interviewed has initiatives related to youth employment, job training, growing and cooking healthy food and enterprise development via market gardens. "We have six urban gardens that youth have started exclusively to sell produce to local restaurants," says Maurice Small of City Fresh in Ohio.

Around the country, concerted efforts are being made to at least vegetate vacant lots to minimize airborne dust particles potentially containing lead. While planting grass is an option, neighborhood gardens sprouting fruit and vegetables also sprout community pride. "You can get more volunteers to take care of gardens versus grass," says Tyler. ■

Editor's Note: This October issue of BioCycle will be distributed at EPA's annual Brownfields Conference, to be held November 15-18, 2009 in New Orleans. This special BioCycle report complements a session on Tuesday, November 17th titled, "Brownfields To Urban Gardens: Growing Food, Jobs and Communities."

A PRIMER

URBAN SOIL CONTAMINANTS AND REMEDIATION

Resurgence of interest in urban farms and gardens raises questions about soil contamination, especially lead. This primer provides a basic understanding of the problem, and the solutions available via compost utilization.

Sally Brown

GROWING food crops in backyards and pea patches in cities used to be commonplace. Victory Gardens in World War II supplied up to 40 percent of the produce consumed in the U.S. Now, for a variety of reasons, there is a resurgence of interest in growing food. Home grown or locally grown generally means better nutrition, lower transport costs, and a lower carbon footprint. It also helps people reconnect with the process of how things grow and where food comes from, teaches kids about their environment and provides significant savings on grocery bills.

However, things have changed since WW II. Our understanding of how things grow and what constitutes a healthy soil are in many ways less sophisticated than they were 70 years ago. In addition, we have done a fair bit of damage to our urban soils since WWII. Most urban soils have elevated concentrations of a range of contaminants including lead and PAHs (poly aromatic hydrocarbons). Soils have also been built on, parked on, and largely ignored. In order to have this resurgence in urban agriculture grow and flourish, it is important to disseminate information on the unique characteristics of urban soils and how to work with them.

People who have just discovered the seed section in their local hardware store will have to confront two sets of obstacles — contaminants and poor soil — before they can successfully create their own urban jungle. Conquering these two problems requires two sets of skills. For contaminants, the basic tool required to garden is knowledge. Just because a contaminant can be measured, does that mean there is a danger associated with eating food grown in that soil?

For poor soil, a different and more fundamental type of knowledge is required. Here, a basic understanding of how soils function and knowledge of what inputs can improve that function is key. For the urban gardener, it just so happens that improving soil function can lead to both reduced contaminant concentration and potentially reduced bioavailability of the contaminants.

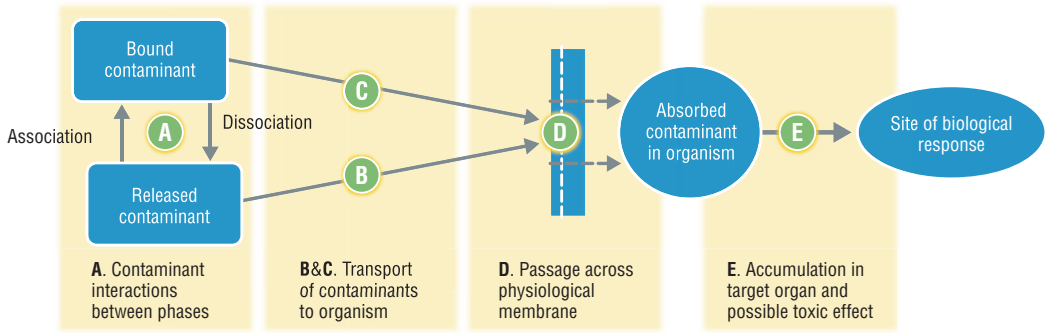
PRIMER ON CONTAMINANTS

For urban soils, a contaminant can be considered a compound that is present in soils at higher concentrations than would be expected, and that has a potential to cause harm as a result of these elevated concentrations. For example, cadmium can be detected in all soils, generally at concentrations less than 1 part per million. A contaminated soil would have cadmium concentrations above the level that is normal for that area. To decide if this elevated cadmium is something to be concerned about, it is critical to realize that the potential for a contaminant to cause harm is related to several factors:

- How high the concentration is in soils;
- What are the different ways (pathways) that the contaminant can cause harm to those exposed to the soil;
- Frequency of exposure to the contaminant by each of the different pathways.

These questions form the basis of an understanding of bioavailability. The bioavailability of a contaminant is a measure of the portion of the total contaminant that has the potential to harm a living thing. The bioavailable concentration of a particular contaminant will vary based on the route of exposure and the end receptor. Figure 1 is a diagram used to explain the bioavailability concept in a National Academy of Science

Figure 1. Bioavailability processes in soil or sediment



SOURCE: National Research Council

study on the Bioavailability of Contaminants in Soils and Sediments (2002).

For urban soils, the most ubiquitous contaminant is lead. The question is: Is eating food grown on lead contaminated soil a concern? Luckily, a lot of prior research has been done to understand the hazards posed by elevated soil lead.

SOIL LEAD

According to the U.S. Centers for Disease Control and Prevention, lead poisoning is the most common and serious environmental disease affecting young children. This is particularly a problem for young children living in urban areas (Ryan et al., 2004).

Current sources of lead in the environment are the remnants of a long history of lead use. Lead was added to gasoline as an antiknock agent. Lead paint was another source of lead in the environment. Although both of these uses of lead were banned over 40 years ago, elevated lead in urban environments is a reminder of our history of widespread use of lead.

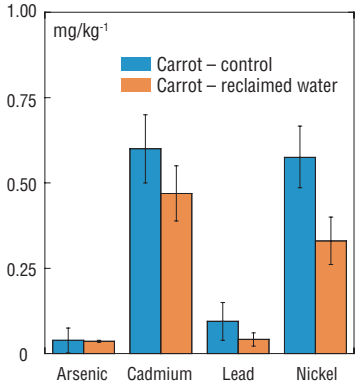
Urban areas, particularly neighborhoods with older homes and busy streets, are centers for lead contamination. Lead is very insoluble in soils and will stay in the soil surface. As a heavy metal, lead will accumulate in soils. Median concentrations of lead in inner city soils are greater than 1,000 ppm.

Elevated soil lead is a problem for young children. Children are more at risk than adults from elevated soil lead because they are still growing and will absorb lead more easily than adults. The primary exposure pathways for soil lead are direct ingestion of soil and inhalation of lead contaminated soil particles. Little children play outside and will deliberately (pica behavior) or inadvertently eat soil. When they eat dirt they will be exposed to the lead in the soil. A healthy plant cover on lead contaminated soil will reduce the potential for dispersal through wind of the soil. It will also make it more difficult for a child to find dirt to play in.

If a child eats soil on an empty stomach, an empty stomach is very acidic and the lead in the soil will become soluble and can be absorbed into the body. Conversely, the soil is never acid enough to make lead soluble. Plants don't need lead to grow. Plant concentrations of lead, even in severely contaminated sites, while above detection, are generally in the very low ppm range. Eating vegetables grown in lead-contaminated soil is generally not a concern. As our ability to measure concentrations of lead becomes more sophisticated, we are able to detect lead concentrations in plants in the parts per billion range.

Figure 2 shows lead, arsenic, cadmium and nickel concentrations in carrots grown in a greenhouse study using soils from a truck farm garden irrigated with tap water and reclaimed water from a wastewater treatment plant. Lead in carrots was above detection limits. However, this is not a reason to avoid eating carrots. The potential for the lead in the carrots to cause harm is limited by two factors: 1) Lead in the carrots will not be readily absorbed into your body as your stomach pH when you are eating becomes less acid, reducing the solubility of the lead; and 2) The portion of your diet from the carrots and other vegetables from a home garden is likely to be low in comparison to the portion from agricultural soils where plant lead and other contaminant concentrations are likely to be even lower.

Figure 2. Greenhouse study growing carrots in soils irrigated with tap water (Control) and reclaimed water (RW) from wastewater treatment plant



The primary danger with elevated lead in urban soils is for children who eat soils. Children are both more likely to eat soils than adults and are more efficient at absorbing any lead that may be in the soil. A thick thatch of grass will reduce the potential for children to have contact with lead contaminated soils.

The standard way to fix lead-contaminated soils is to remove the soil and replace it with clean soil. This is very expensive. It is difficult to find a disposal site for contaminated soils and also difficult to source clean topsoil. The only sites where this type of remedy has been used are the most severely contaminated sites where industrial activities are the cause of contamination. Sites on the USEPA National Priorities List (Superfund sites) have used removal and replacement of contaminated soils as a way to clean up contamination.

In inner cities where soil lead is often higher than on Superfund sites, there is no source of funding to clean up soils. In some cases volunteer organizations provide educational guides to reducing the risks posed by excess lead in soils. The Kennedy Krieger Institute is an example of an organization that offers educational materials on soil lead (www.kennedykrieger.org/kki_diag.jsp?pid=1090). These guides often recommend things like washing your hands before you eat and keeping a clean house. In other cases, nothing is done to reduce the danger posed by excess soil lead. However, selecting tools to make plants grow better will also work to reduce hazards posed by elevated soil lead concentrations.

Figure 3. Vegetables grown in a commercial topsoil blend (left) versus commercial topsoil blend mixed with 50 percent biosolids compost (right)

COMPOST FOR URBAN GARDENS

Because compost provides both fertility and organic matter to soils, plants grown with composts tend to be bigger and greener than plants grown in poor soils. Urban soils tend to be highly compacted and low in nutrients. Adding composts to urban soils will generally increase plant growth. Vegetables grown in a commercial topsoil blend versus a commercial topsoil blend mixed with 50 percent biosolids compost are shown in Figures 3a and 3b, respectively.

Adding composts to soil will also reduce the lead concentration in the soil, thereby reducing hazards posed by soil lead. Although composts will have measurable concentrations of lead, these will be much lower than the soil and will dilute the soil. Metal concentrations for two different composts are listed in Table 1. One is made from yard waste and food scraps. The other is made from biosolids and sawdust.

Compost was added to a lead contaminated orchard soil in a field study to test the ability of the compost to reduce the availability of soil lead. Lead arsenate pesticides were routinely used in orchard soils in the early part of the 20th century. The change in total soil lead concentration after addition of 10 percent by weight biosolids compost is shown in Figure 4.

If the top 3-inches of a lead-contaminated soil is mixed 1:1 with biosolids compost, the lead concentration in the soil will be diluted by approximately half.

Table 1. Metal concentrations in two composts, and state pollutant limits

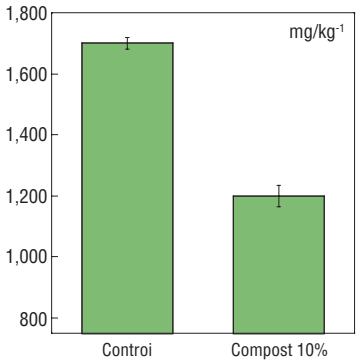
Metals	*Cedar Grove Food & Yard*	*GroCo/ Biosolids*	*Washington Compost Limits*
	(parts per million)		
Arsenic	6.6	2	20
Cadmium	1.6	1	10
Copper	45	136	750
Lead	37	19	150
Mercury	<1	0.38	8
Molybdenum	1.1	3	9
Nickel	21	8	210
Selenium	<1	2.3	18
Zinc	170	261	1400

In addition to dilution, studies have also shown that some biosolids composts, primarily those high in iron, can reduce the availability of soil lead (Brown et al., 2002; 2004). The high iron composts form bonds with the lead. Both lab tests and animal feeding studies have shown that these composts reduce the fraction of the lead that can be absorbed. In a feeding study mixing a high iron compost produced in Washington D.C. with soil from a Superfund site in Joplin, Missouri, lead availability was reduced by 25 percent in comparison to the un-

treated soil. This reduction was in addition to the dilution effect mentioned earlier.

This means that for people living in an urban area who are concerned about the potential for high lead in their soil causing harm to children, an easy and effective solution is adding compost to their gardens. Composts will have low lead concentrations. They will be great for plants. Adding high rates of compost to soils will dilute soil lead and promote lush plant growth. Both make lead in the soil much less of a concern.

Figure 4. Change in total soil lead concentration after addition of 10% (by weight) biosolids compost



OTHER CONTAMINANTS

Urban soils also can contain elevated concentrations of contaminants other than lead. These include other metals as well as organic compounds. Plant uptake of organic chemicals is generally minimal (Luthy et al., 2002). This means that when considering the bioavailability of organic compounds, plant uptake is not a pathway of concern. In other words, concerns about organic contaminants in gardens should not be a consideration when growing food crops.

Knowing the history of industrial activities can be a clue to determining the likelihood of elevated contaminant concentrations. In Tacoma, Washington, for example, a metal smelter operating for many decades resulted in elevated lead and arsenic in city soils. Generally, if contamination is of sufficient magnitude to be concerned about, public health officials in a municipality will be cognizant of these contaminants.

For the urban gardener, potentially the most important consideration before starting a garden is the level of neglect suffered by the soils. Urban soils are nutrient poor, highly compacted and lacking in organic matter. All of these factors make growing a successful garden difficult. For all of these problems, adding high rates of compost will markedly improve your soils. In addition, using high rates of compost will reduce the concentration and potentially the bioavailability of any contaminants that may be in the soil. Compost will also bring you an excellent chance of a bountiful harvest. ■

Sally Brown is a Research Associate Professor at the University of Washington. For more information on Dr. Brown's research related to soil lead remediation, visit http://faculty.washington.edu/slb/.

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