

DYNAMIC WORKPLANS & FIELD ANALYTICS:

The Key to Cost Effective Site Cleanup

Produced by TUFTS UNIVERSITY

1 (Title Screen: HANSCOM AIR FORCE BASE, 1996)

2 MALE VOICE: They know we have a problem.

3 FEMALE VOICE: Typical of a federal facility,  
4 multi-sites.

5 ROBERT SPELFOGEL, RESTORATION SECTION, HANSCOM  
6 AFB: We have ground-water contamination, and we found that  
7 contaminants are in the aquifer.

8 BOB LIM, EPA PROJECT MANAGER: There are still  
9 unanswered questions.

10 THOMAS BEST, RESTORATION PROJECT MANAGER, HANSCOM  
11 AFB: The current process has been frustrating. It's like a  
12 snowball coming down a hill. It just got bigger and bigger.  
13 So I'm looking at finding a way to expedite the cleanup to  
14 get more for my money.

15 NARRATOR: Today, tens of thousands of hazardous  
16 waste sites on the Superfund, RECRA, and Brownfields lists  
17 await characterization and cleanup. At a small percentage  
18 of these sites, the tip of the iceberg, remediation is  
19 already underway. To date, billions of dollars have been  
20 spent on the traditional phased engineering approach, in  
21 which samples are collected, shipped off-site for analysis,  
22 and the data returned long after the sample collection crews  
23 have gone.

24 STEVE LUFTIG, DIRECTOR, EPA OFFICE OF REMEDIAL  
25 RESPONSE: The cost of soil assessment has to come down.

26

1           ANDREW BELIVEAU, EPA QUALITY ASSURANCE: We have  
2 lots of sites that aren't being worked on because of budget.

3           DAN TOWMEY, FIELD CHEMIST/SITE WORKS: The  
4 industry now says look, we have X dollars. We have big  
5 problems. We are tired of study, study, study. Let's get  
6 moving. Let's get these things done.

7           MR. LUFTIG: We need a balanced program that  
8 recognizes that there are field analytic methods that work.

9           BOB CAMPBELL, ENVIRONMENTAL ANALYST, MA DEP:  
10 Anytime you find a technology which will shorten the amount  
11 of time it takes to remediate a site, it is always looked on  
12 with some favor.

13           NARRATOR: Field Analytics provides a process for  
14 dynamic site characterization and cleanup with a workplan  
15 that is not etched in stone, but that can be changed or  
16 modified as results from the field are evaluated in real  
17 time. Decisions as to which sample should be analyzed and  
18 for what contaminants can be made in the field, allowing for  
19 a faster and more effective site characterization process.

20           DYNAMIC WORKPLANS & FIELD ANALYTICS:

21           THE KEYS TO COST-EFFECTIVE SITE CLEANUP

22           NARRATOR: Like many Air Force sites, from the  
23 early 1940's to the mid-1970's, Hanscom Field generated a  
24 wide range of waste oils, fuels, solvents, and chemicals

25

1 from operations, maintenance, and fire training activities.  
2 Previous disposal practices for many of these chemicals have  
3 caused contamination of the adjacent ground water. Between  
4 1987 and 1988, the Air Force removed all visibly  
5 contaminated soil in drums from three sites in an effort to  
6 stem the pollution. Unfortunately, considerable amounts of  
7 hazardous waste had already migrated to the water table.

8 In 1991, a ground-water collection, recharge, and  
9 treatment system was placed in operation to remediate the  
10 effected sites and contain the plumes of contaminated  
11 ground water. Ultimately, the Hanscom sites were added to  
12 the National Priorities List in 1994. Overall, over \$25  
13 million has been spent at Hanscom on traditional hazardous  
14 waste site investigations and clean up.

15 MR. BEST: In the late '80's we went in and we  
16 removed the basic sources, the drums, and any visibly  
17 contaminated soil, and we put in a treatment system. And  
18 that treatment system came on-line in '91. We have been  
19 operating it for over five years now. We have treated over  
20 500,000,000 gallons of water.

21 MR. BELIVEAU: Some of the monitoring wells show  
22 that it is still there. In fact, several of the monitoring  
23 wells shows that there is very, very high contamination down  
24 below which isn't being pulled from the ground.

25 MR. SPELFOGEL: Pump and treat hasn't been working  
26

1 very efficiently, and right now we are trying to go after  
2 the sources that we haven't been collecting.

3 MR. BEST: The previous investigations I don't  
4 think have given us any answers.

5 RICH LANDRY, CHIEF OPERATOR, METCALF & EDDY: We  
6 know it's out there. It's just getting into a treatment  
7 facility.

8 MR. BEST: I just cannot see the light at the end  
9 of the tunnel. Am I ever going to complete this cleanup or  
10 not?

11 NARRATOR: Given the readings from the wells and  
12 treatment facility, it became clear that there was still a  
13 need to determine the location and extent of contaminated  
14 materials remaining in the ground. In 1996, as part of  
15 President Clinton's Environment Technology Initiative, a  
16 grant was awarded to Professor Albert Robbat of the Tufts  
17 Center for Field Analytical Studies and Technologies.

18 Dovetailing with the ETI's strategic plan for  
19 developing and commercializing promising new environmental  
20 technologies, the Tufts project was directed at two key  
21 objectives identified in the strategic plan. First, to  
22 strengthen the capacity of technology developers and users  
23 to succeed in environmental innovation. And two, to  
24 strategically invest EPA funds in the development and  
25 commercialization of promising new environmental monitoring,  
26

1 control, and remediation technologies.

2 Tufts and several commercial companies sought to  
3 demonstrate their field analytical instrumentation in the  
4 context of a dynamic workplan which relies on an adaptive  
5 sampling and analysis strategy. The goal was to better  
6 characterize the Hanscom site so that a more effective  
7 collection and treatment system could be developed, and to  
8 determine the potential risk of contaminated soil to  
9 ground water. Based on the ETI project, a guideline was  
10 prepared for implementing dynamic workplans employing  
11 innovative field analytical instrumentation.

12 JAMIE MAUGHAN, CH2M HILL: Today we have put  
13 together a data collection program for one of the sites out  
14 at Hanscom, and there are still some areas that we need to  
15 iron out where different people have different impressions  
16 of how the samples should be collected, when they should be  
17 collected. So we are going to iron out those and then set  
18 up the logistics, so we can move forward and start the  
19 sampling here in just two weeks.

20 MR. SPELFOGEL: We are just fine-tuning the  
21 project, make sure that everybody understands what they need  
22 to be doing in the field.

23 DYNAMIC WORKPLAN GUIDELINE

24 NARRATOR: The following six steps can be used as  
25 a guideline to develop a typical dynamic workplan.

26

1           1. Select Core Technical Team to Prepare Workplan.

2           NARRATOR: The technical team should possess  
3 expertise in analytical chemistry, geophysics, geology,  
4 hydrogeology, and risk analysis. At least one member of the  
5 technical team should be on site at all times and have a  
6 working knowledge of all aspects of the investigation.

7           2. Develop Initial Conceptual Model and Decision  
8 Making Framework.

9           NARRATOR: The initial conceptual model contains  
10 the best available information at the start of the project.  
11 It depicts the three dimensional site profile based on  
12 vadose zone and ground-water flow systems that can exert  
13 influence  
14 on contaminant movement. The initial conceptual model is  
15 based on the data quality objectives for the site. The DQO  
16 process involves a series of planning steps designed to  
17 ensure that the type, quantity, and quality of environmental  
18 data used in decision-making are appropriate for answering  
19 site-specific scientific and engineering questions.

20           3. Prepare Standard Operating Procedures for  
21 Adaptive Sampling and Analysis Program.

22           NARRATOR: Standard operating procedures should be  
23 developed for sample collection and analysis to answer site-  
24 specific questions. Field analytical instrumentation may  
25 not be amenable to typical CLP or SW-846 methods, QC  
26 procedures, or data reporting formats. Supporting data for  
27

1 innovative field analytical instrumentation should be  
2 provided to document data quality.

3 4. Develop Data Management Plan.

4 NARRATOR: Critical to the success of the dynamic  
5 investigation process is the ability to manage and easily  
6 use all data produced in the field. Protocols for sample  
7 logging, analysis, data reduction, and site mapping should  
8 be established with rules and responsibilities defined prior  
9 to mobilization.

10 5. Develop Quality Assurance Project Plan.

11 NARRATOR: The quality assurance project plan  
12 describes the procedures to be used to monitor conformance  
13 or deviation from the SOPs. The overall goal is to ensure  
14 that data of known quality has been produced to support the  
15 decision-making process.

16 6. Prepare Health and Safety Plan.

17 NARRATOR: The health and safety plan is produced  
18 to protect both workers and the community during a site  
19 investigation and cleanup. This diagram illustrates the  
20 adaptive sampling and analysis strategy for a hypothetical  
21 soil screening site investigation whose goal is to determine  
22 contaminant risk to ground water and human health. The  
23 figure shows the decision-making flowchart for the  
24 investigation.

25 Typically, several sampling rounds are required

26

1 before confidence in the conceptual model can be obtained.  
2 The number of sampling rounds made during the same  
3 mobilization is dependent upon the DQO specifications for  
4 confirming the absence or presence of contaminants. If  
5 contaminants are present, the extent, direction,  
6 concentration, rate of contaminant migration, volume of  
7 contaminated soil, and its risk to ground water and human  
8 health should be determined prior to concluding the  
9 investigation.

10           Once the conceptual model has been verified, each  
11 site investigated should fall within one of three  
12 categories: the site is clean or poses acceptable risk, no  
13 further action required; the site is highly contaminated and  
14 well above action levels for acceptable risk, remedial  
15 action begins; or the site poses marginal risk, a  
16 cost/benefit analysis determines that an immediate cleanup  
17 is not warranted. The core technical team determines  
18 whether future action is needed.

19           When developing a dynamic workplan, regulators  
20 should be included as part of the core technical team to  
21 ensure effective decision-making in the field. Stakeholders  
22 should agree at the beginning on the most likely kinds of  
23 actions to be taken as a result of the field data. The  
24 field team should implement the appropriate actions on a  
25 daily basis as data is generated, and take new directions

26

1 when the data suggests deviations from the conceptual model.

2 MR. CAMPBELL: Cleaning up a site of hazardous  
3 waste is not a simple thing. It requires some time. It  
4 takes planning.

5 MR. LIM: It's important to look at new  
6 technologies because there is definitely a possibility of  
7 saving a lot of time and money in the investigation  
8 process.

9 MR. MAUGHAN: It's a new, innovative approach.

10 MR. TOWMEY: People don't expect that you can move  
11 high-tech equipment or analytical equipment to the field.  
12 The analytical techniques and the science you are doing is  
13 the same science no matter what location you are in.

14 UNIDENTIFIED MALE: You can collect a lot of  
15 samples quickly, have them analyzed, and then make changes  
16 in your sampling program based upon what you see in the  
17 field.

18 MR. BELIVEAU: We are not having a huge drill rig  
19 go down and bore a big, thick hole. We have got a smaller  
20 drill rig going down and taking smaller samples. And you  
21 can take ten times more samples than you do with a big drill  
22 rig.

23 MR. TOWMEY: It is very fast at getting soil  
24 samples and getting water samples.

25 UNIDENTIFIED MALE: You can chase a plume, you can  
26

1 quickly define the limits of the contamination.

2           NARRATOR: At the Hanscom site, the core  
3 technical team employed a geoprobe for rapid sample  
4 collection and field laboratories for the rapid screening  
5 and quantitative analysis of chlorinated solvents, gasoline  
6 constituents, polychlorinated biphenyls, PCBs, polycyclic  
7 aromatic hydrocarbons, PAHs, as well as the target analyte  
8 list of metal contaminants and organics.

9           The team reviewed the data as it was produced in a  
10 separate trailer where data collection and analysis was  
11 performed. Site maps were produced illustrating the extent  
12 of subsurface contamination. Subsurface soil samples were  
13 collected in four foot tubes. At one-foot intervals, an  
14 incision was made with a direct measuring, fast, GCMS soil  
15 probe placed over the incision. Each four foot tube was  
16 screened to determine which section of the tube, if any,  
17 should be further analyzed by quantitative GCMS in the field  
18 to confirm screening results and to select the next round of  
19 soil samples to be collected. Fast screening tools like  
20 GCMS and in situ fiber optic sensors allow for real-time  
21 on site decision making.

22           MR. TOWMEY: You can quickly map out what  
23 concentrations of contaminants at a site, and you can get  
24 the job done in one field session, a week or so, typically,  
25 for a site like this.

26

1           NARRATOR: As an example, three rounds of soil  
2 samples were typically collected. At site two, only two  
3 rounds of soil samples were necessary to determine the  
4 boundaries of subsurface soil contamination. Tufts also  
5 provided quantitative GCMS for VOCs PCBs, and PAHs. This  
6 data was used to support risk analysis for soil-to-ground-  
7 water contamination.

8           DR. ALBERT ROBBAT, JR., TUFTS UNIVERSITY CHEMISTRY  
9 DEPARTMENT, DIRECTOR, CFAST/ETI PROJECT MANAGER: The total  
10 line current mass spectral signal shown here is from an oil-  
11 contaminated soil extract. The heart of the technology is a  
12 set of mathematical algorithms called the ion fingerprint  
13 detection. The software extracts target compound ions,  
14 typically four ions per compound, and calculates, from the  
15 signals extracted, characteristic patterns that are used to  
16 identify and quantitate the target compounds. Both PCBs  
17 and PAHs present in the sample were analyzed in under ten  
18 minutes with no sample cleanup prior to analysis.

19           Really, it is a productivity enhancing tool. What  
20 it means is that we can analyze many more samples per day  
21 than traditional laboratory instruments. We can do it at  
22 less cost, which means we get more data for the same  
23 amount of money. All of that tied together means we get  
24 more information about the nature of the site. It is this  
25 software that allows us to rapidly analyze samples and  
26

1 obtain the data from those samples to make decisions in the  
2 site. It is the core technology that will allow us to bring  
3 the next generation of instruments to the field.

4           NARRATOR: In the metals trailer, soil analysis is  
5 performed via ICP. Extraction of the metals out of the soil  
6 prior to ICP is done through a Tufts-developed microwave  
7 digestion procedure. Specially adapted laboratory equipment  
8 with lock-down optics is used in the closely monitored,  
9 controlled environment. All of the sample data is  
10 electronically transferred to the data management trailer,  
11 where it is processed and developed into computer-based site  
12 visualization maps.

13           The combination of ion fingerprint detection  
14 software and thermal absorption GCMS provided instantaneous  
15 measurement of 600 soil samples and quantitative analysis of  
16 another 180 soil samples for VOCs, while 70 soil samples  
17 were analyzed quantitatively for PCBs and PAHs. Both the  
18 VOC and PCB/PAH analyses were accomplished in ten minutes  
19 per sample. Over 100 soil samples were analyzed on site by  
20 field ICP for the target analyte list metals. All in all,  
21 nearly 1,000 analyses were performed over a two-week period.

22           A number of VOCs were found in each of the three  
23 sites in varying concentrations. No PCBs or PAHs were  
24 found above the risk-based soil screening levels, while at  
25 one site, cadmium and lead concentrations were found above

26

1 the levels established for the investigation. Calculations  
2 were made to estimate the volume of contaminated soil with  
3 the field data used to support the on site decision-making  
4 process.

5 MR. BEST: That is the benefit that I see, to  
6 complete in two weeks what it would normally, I would  
7 program it at least 18 months to two years to do.

8 MR. SPELFOGEL: Congress wants us to streamline  
9 the whole process.

10 MALE VOICE: It is important to embrace new  
11 technologies.

12 MR. BEST: To use them will allow us to do this  
13 site characterization faster, quicker, cheaper.

14 MR. BELIVEAU: This idea of having to get quick  
15 turnaround analyses will save a lot of money.

16 MR. BEST: I am very pleased with this project.  
17 We are collecting an awful lot of samples and data and I  
18 think it was very successful for all parties involved.

19 MR. CAMPBELL: The technology has been proven. I  
20 think what has to happen is that the information that is  
21 generated from this report has to go public so that people  
22 understand that it is a technology that works.

23 MR. LUFTIG: Tufts has been a real leader in  
24 developing and getting real equipment used that really  
25 implements what the Environmental Technology Initiative was  
26

1 intended to accomplish. Here, we have got methods that can  
2 literally be seconds instead of weeks, pennies instead of  
3 hundreds of dollars. And I think that has to get everyone's  
4 attention.

5 MR. BELIVEAU: We have to get it out to EPA  
6 nationally, say this is what you can do.

7 MR. LUFTIG: It is frustrating to know that all of  
8 our project managers in all of our regions and all of the  
9 states aren't yet fully on board with the use of the  
10 methods.

11 MR. BELIVEAU: Right now, the consultants have got  
12 to get into the program.

13 MR. LUFTIG: The consultants and the regulatory  
14 agencies can save a great deal of money and time on each  
15 site and get onto the other sites, and just get more done.

16 LINDA MURPHY, DIVISION DIRECTOR, EPA REGION ONE,  
17 OFFICE OF SITE REMEDIATION & RESTORATION: Every dollar that  
18 we spend on site characterization is a dollar that we can't  
19 spend on site cleanup. Every month that we spend on  
20 characterization is a month that we should be spending  
21 cleaning up the site. We want to move these sites out of  
22 the study stage, out of the characterization/study stage,  
23 and into the cleanup stage.

24 NARRATOR: Dynamic investigations employing field  
25 analytical instrumentation and methods provide a host of  
26

1 benefits. To federal and state regulators, by obtaining  
2 more information about the hazardous nature of a site,  
3 reducing the uncertainties associated with risk-based  
4 decision-making. To site owners and their consulting  
5 engineers, by completing the investigation process in a more  
6 timely and cost-effective manner. And to the community  
7 itself, with increased knowledge about the site ensuring  
8 faster, better, cheaper site remediation.

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24