Final Report

Department of Civil and Environmental Engineering Equipment Grant

W.M. Keck Foundation

December, 2000
EXECUTIVE SUMMARY

The Keck Equipment grant, received by the CEE Department at WPI on July 1999 is clearly instrumental to a number of significant advancements. Physical renovations supported through WPI’s Capital Campaign at a cost of $1.12 M for both the Highway Infrastructure Program laboratories and the Environmental Infrastructure Program laboratory have been completed. Two new equipment grants have been awarded to the HIP laboratory facilities totaling $131,500. Faculty members in both the HIP and EIP programs have submitted $2.4 M in research proposals and have received $0.8 M to date.

Two new positions have been added to the CEE Department staff for laboratory support (Laboratory Manager and a Part Time Secretary). A third position has been added to the CEE Department staff for research activity support (Asphalt Research Engineer). Two new tenure track faculty members with laboratory-based research experience have been added to the EIP group (Professors Plummer and Bergendahl). WPI seed money supplied with these new faculty is supplementing the Keck equipment grant and helping to further establish a state-of-the-art environmental research and teaching facility.

Faculty members in both the HIP and EIP groups are actively working to meet this new challenge and will continue to contribute to their respective fields for many years to come. Peer reviewed research papers and presentations at research conferences have been made as a result of equipment now available in these laboratories. A listing of these papers is presented in the body of this report. These new teaching and research facilities provide hands-on training and state-of-the-art research projects that were not possible before. New teaching programs (an asphalt training program and a unit operations environmental engineering course) have also been established as a result of this new equipment.
## TABLE OF CONTENTS

**PROGRESS**  1  
  Equipment Purchased  
  Personnel Hired  
  Faculty Members Appointed  
  Laboratory Renovations  
**PROBLEMS ENCOUNTERED AND HINDSIGHT**  3  
**ADDITIONAL SUPPORT RECEIVED**  3  
**IMPACTS OF THIS GRANT**  4  
**RELATED ACTIVITIES**  5  
  Publications and Presentations  
  New Teaching Initiatives  
**FUTURE PLANS**  5  

Appendix I – Total Listing of Keck Grant Equipment Purchases  
Appendix II – Additional Equipment Purchases  
Appendix III – Job Description of Additional Hires  
Appendix IV – Resumes of New Hires  
Appendix V – Resumes of New Faculty  
Appendix VI – Photos of New Lab Facilities  
Appendix VII – Recent Proposals  
Appendix VIII – Recent Publications  
Appendix IX – Recent Presentations  
Appendix X – EIP Distance Learning Program Brochure  

**List of Tables**

Table 1. New Staff Positions for CEE Department  
Table 2. Summary of Renovation Costs  
Table 3. Funded Projects
PROGRESS

This document is the final report for the Keck Foundation equipment grant received by the Department of Civil and Environmental Engineering on July 1999. A summary of all equipment purchased is presented.

Along with the $0.5M supplied through the Keck Foundation equipment grant, additional WPI start-up money totaling $129,730 has been supplied to the CEE Department for laboratory equipment that is now installed in the highway and environmental infrastructure laboratories. Recent equipment grants totaling $131,500 have been awarded by outside agencies to support these laboratories.

Related activities that are a direct result of the Keck Foundation equipment grant are outlined in this report. These activities include new staff additions, undergraduate and graduate student project plans, research proposal submissions and awards, and publications.

Equipment Purchased

As shown by Appendix I, the total purchases at the close of this grant period account for 100% of the $0.5M awarded. Final delivery of one major piece of equipment (the Axial Servohydraulic testor) is being delayed until laboratory renovation details in the structural analysis area are complete. All other equipment is in the process of final shakedown operations or is actively being used for research projects. Both undergraduate and graduate research projects are in progress during this academic year to make full use of this equipment.

Other equipment purchases have been financed through new faculty seed money and other equipment grants. Appendix II summarizes these purchases.

As can be seen from Appendices I & II, the total equipment purchases over the last twelve months total to about $782,000.

Personnel Hired

Two WPI staff positions (one secretary and one laboratory manager) have been added to the Civil Engineering Department team to support new activities related to the EIP and HIP laboratories. A research staff position (supported through outside funding sources) has also been added. Table 1 lists these positions. Job descriptions and resumes of each person hired to fill these positions are presented in Appendix III and IV respectively.
Table 1 - New Staff Positions for CEE Department

<table>
<thead>
<tr>
<th>Name</th>
<th>Date Hired</th>
<th>Brief Job Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brenda May</td>
<td>Nov-99</td>
<td>Assist Faculty with Research Activities</td>
</tr>
<tr>
<td>Don Pelligrano</td>
<td>Jan-00</td>
<td>Oversee All Laboratory Operations</td>
</tr>
<tr>
<td>Matthew Teto</td>
<td>Jan-00</td>
<td>Asphalt Laboratory Research</td>
</tr>
</tbody>
</table>

Faculty Members Appointed

The Environmental Infrastructure Program has added two new faculty to their group. Both faculty are full time tenure track assistant professors. They are Professors Jeanine Plummer and John Bergendahl. Resumes of these new faculty members are shown in Appendix V.

Laboratory Renovations

The Civil Engineering Department Infrastructure Laboratories (HIP and EIP) have been completely renovated. The cost for this renovation significantly exceed the original estimate of $0.5 M by about $0.6 M, bringing the total cost to more than $1.12 M. Photos of these new renovations are shown in Appendix VI. Table 2 summarizes the costs for these renovations.

Table 2 – Summary of Renovation Costs

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>General (supervision, clean-up, permits …)</td>
<td>$100,258</td>
</tr>
<tr>
<td>Architecture and Engineering Fees</td>
<td>$65,000</td>
</tr>
<tr>
<td>HIP Lab</td>
<td>$437,575</td>
</tr>
<tr>
<td>EIP Lab</td>
<td>$415,053</td>
</tr>
<tr>
<td>Common areas (hallway, bathrooms, shop …)</td>
<td>$106,510</td>
</tr>
</tbody>
</table>

TOTAL $1,124,396

The original estimate for physical renovations was expected to match the Keck Foundation equipment grant. Spiraling construction costs and unforeseen needs for building infrastructure upgrades, however, increased the total renovation costs. The final laboratory renovation cost is about 212% of the Keck Foundation support. WPI,
therefore, has significantly exceeded the original projection to match the Keck Grant with renovation money.

PROBLEMS ENCOUNTERED AND HINDSIGHT

In most areas, this grant functioned smoothly and had minimal impact on the normal operations of the department. Laboratory renovation during the summer period when student populations and teaching activities were low was successful. Weekly meetings with the architect and the contractor throughout the renovation period were very useful and avoided many unforeseen problems. During the renovation periods, new equipment was received and set-up at other areas with little difficulty. Large equipment such as the Atomic Absorption Spectrophotometer and the Instron Testor could not be set-up in temporary locations however. Late installations of these devices could not be avoided.

Early estimates of infrastructure support needs for much of this new equipment were underestimated or not well known during the proposal writing stage of this project. This is a main reason for the delay in final installation of the Instron Testor – which was found to require a cooling unit for long term operation. Initial plans were to use water for this cooling, but it was later discovered that discharging cooling water to the city sewer system was not allowed (although this practice is still used by many facilities, new installations must comply with new regulations). Likewise, the Atomic Absorption Spectrophotometer was also found to require a separate cooler device for the same reasons. Luckily, the cooler was supplied with the analyzer by the supplier as a new introductory offer.

ADDITIONAL SUPPORT RECEIVED

Appendix VII lists recent proposals that are directly related to laboratory facility use that have been submitted by the EIP and HIP Faculty since the Keck Grant award. As can be seen, the total proposal submissions this period is about $2.4 M.

Table 3 lists recent grants directly related to laboratory facility use that have been awarded to the HIP and EIP Faculty since the Keck Grant award. The total grants awarded during this period is about $0.8 M.

It is expected that this level of support will continue or will increase (with increased EIP activities) in the future.
### Table 3 – Funded Projects

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Faculty</th>
<th>Sponsor</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxidation Reduction Potential Versus Residual Control of Chlorine</td>
<td>J. Bergendahl</td>
<td>D.Williams Assoc</td>
<td>$30,000</td>
</tr>
<tr>
<td>Evaluation of Properties of Subsurface Soils and Reclaim Base Material</td>
<td>R. Mallick</td>
<td>MEDOT</td>
<td>$26,000</td>
</tr>
<tr>
<td>Lab &amp; Field Experience Based Course in Asphalt Tech.</td>
<td>R. Mallick</td>
<td>NSF</td>
<td>$31,479</td>
</tr>
<tr>
<td>Evaluation of Use of Manufactured Waste Asphalt Shingles Hot Mix Asphalt</td>
<td>R. Mallick</td>
<td>UMA</td>
<td>$40,749</td>
</tr>
<tr>
<td>Development of a Rational and Practical Mix Design System for Full Depth Reclamation</td>
<td>R. Mallick</td>
<td>UNH</td>
<td>$141.50</td>
</tr>
<tr>
<td>Evaluation of Permeability of Superpave Mixes</td>
<td>R. Mallick</td>
<td>UMA Dartmouth</td>
<td>$49,723</td>
</tr>
<tr>
<td>Design Alternatives for the Weak Post W-Beam</td>
<td>M. Ray</td>
<td>Bucknell</td>
<td>$43,929</td>
</tr>
<tr>
<td>Center of Excellence in Dyna3d Analysis</td>
<td>M. Ray</td>
<td>DOT</td>
<td>$50,000</td>
</tr>
<tr>
<td>Recommended Guidelines for Curbs and Curb-Barrier Combinations</td>
<td>M. Ray</td>
<td>NAS</td>
<td>$300,000</td>
</tr>
<tr>
<td>Acquisition of Structural Mechanics Testers</td>
<td>M. Ray</td>
<td>NSF</td>
<td>$100,000</td>
</tr>
<tr>
<td>Development of an Improved Roadside Barrier System</td>
<td>M. Ray</td>
<td>UWVA</td>
<td>$60,792</td>
</tr>
<tr>
<td>Side Impact, Finalizing the Test Procedures and Preliminary Countermeasures</td>
<td>M. Ray</td>
<td>Uiowa</td>
<td>$68,291</td>
</tr>
<tr>
<td>Waste Minimization in Food Production</td>
<td>J.O’Shaughnessy</td>
<td>Decas.Cranb.</td>
<td>$6,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>$807,105</td>
</tr>
</tbody>
</table>

### IMPACTS OF THIS GRANT

As noted in the above sections, both the EIP and the HIP faculty groups have been very active in their teaching and scholarship activities since the start of this grant. The new equipment supplied from this grant and the newly renovated laboratory facilities supported by WPI as a matching investment to the grant, are significant reasons for this level of activity. Specific scholarship capabilities resulting from these new facilities are as follows:

- Dynamic structural analysis capabilities, including fatigue testing and impact testing
- Organic measurements in water and wastewater at low concentrations
- Inorganic measurements in water and wastewater at low concentrations
- Microbiological testing in water and wastewater
- Asphalt production testing
- Dynamic testing of asphalt materials
- Environmental impact testing of asphalt materials

The two new teaching initiatives noted above are also only now possible because of these new facilities. Both of these new teaching initiatives require use of the measurement testing capabilities listed above.
At a wider scale, these new facilities impact prospective students and their parents, accreditation reviewers, prospective faculty and staff and the entire undergraduate and graduate student population. Influences range from a non-tangible sense of pride to the tangible improved analytical capabilities which will open opportunities for scholarship and teaching activities that have not be available before.

RELATED ACTIVITIES

Publications and Presentations

Appendices VIII and IX list publication and presentations made since July 1999 by faculty in the HIP and EIP groups. As can be seen, the topic matter in these listings is closely related to laboratory based studies. With the addition of equipment supplied through this grant, these type of studies will clearly continue and expand.

New Teaching Initiatives

Two new teaching initiatives have developed as a result of new equipment added to the EIP and HIP laboratory facilities.

- An Asphalt Technology Course
- A Unit Operations/Process Environmental Laboratory Course

A field and laboratory based coursework in asphalt technology was developed with the help of a grant from the National Science Foundation. The objectives of this project are to provide the undergraduate students with tools for field experience in asphalt pavement construction, including quality control techniques, and to teach concepts of statistical quality control through analysis of real time quality control test data. As part of the field and laboratory work for this newly developed course, students used testing equipment in the field and analyzed data with portable computers and data analysis software. The students participated in the fieldwork to gain experience in operation of equipment, understand techniques of proper interpretation of test results and making decisions based on test results.

A new unit operations laboratory course is presently being developed by Professors Bergendahl and Plummer for the EIP graduate program. This course will focus on environmental laboratory experiments that demonstrate the use of analytical instruments for analysis of environmental samples. Substantial time will be spent on development, testing and optimization of an environmentally-based design project.

FUTURE PLANS

Both the EIP and HIP faculty groups will continue making strives in teaching and scholarship areas and will continue to support these new laboratory facilities. Plans are
to integrate the new EIP laboratory facility with our new distance learning program. Appendix X contains a brochure printout of this new program. Further information on the EIP distance learning program may be found at: http://www.wpi.edu/+CEE/ADLN.

The next initiative planned for physical upgrade of the CEE laboratory facilities will be to renovate the geotechnical engineering laboratory – which represents the remaining one-third of the total laboratory space of the department.
Appendix I

Total Listing of Keck Foundation Equipment Grant Purchases
<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
<th>Company</th>
<th>Paid</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/19/03</td>
<td>Model 8250HV Drop weight impact test instrument</td>
<td>Instron Corp.</td>
<td>$60,741.00</td>
</tr>
<tr>
<td>2/8/04</td>
<td>Freight Charges</td>
<td>Instron Corp.</td>
<td>$228.06</td>
</tr>
<tr>
<td>3/2/04</td>
<td>Tinius Olson Retrofit</td>
<td>Instron Corp.</td>
<td>$21,259.00</td>
</tr>
<tr>
<td>6/28/04</td>
<td>Axial Servohydraulic</td>
<td>Instron Corp.</td>
<td>$171,926.00</td>
</tr>
<tr>
<td>9/2/03</td>
<td>Thermolyne NCAT Asphalt content tester</td>
<td>Barnstead/Thermolyne</td>
<td>$7,922.82</td>
</tr>
<tr>
<td>10/5/03</td>
<td>Zeitzfuhs Viscometer ASPH Inst. Vac Viscometer</td>
<td>Gilson Company</td>
<td>$120.00</td>
</tr>
<tr>
<td>9/29/03</td>
<td>Portable Mixer</td>
<td>Gilson Company</td>
<td>$406.00</td>
</tr>
<tr>
<td>9/29/03</td>
<td>Deluxe Paddle/M-66</td>
<td>Gilson Company</td>
<td>$42.70</td>
</tr>
<tr>
<td>9/29/03</td>
<td>Pail &amp; Cover/M-66</td>
<td>Gilson Company</td>
<td>$23.60</td>
</tr>
<tr>
<td>11/5/03</td>
<td>Quantitative EXT &amp; Rec of ASPH Binder/RHE TSTG</td>
<td>Gilson Company</td>
<td>$14,300.00</td>
</tr>
<tr>
<td>9/2/03</td>
<td>Asphalt Pavement Analyzer</td>
<td>Pavement Technology</td>
<td>$84,325.00</td>
</tr>
<tr>
<td>10/8/03</td>
<td>Electric Penetrometer</td>
<td>Gilson Company</td>
<td>$2,701.00</td>
</tr>
<tr>
<td>10/8/03</td>
<td>Wax Penetration needle for penetrometer</td>
<td>Gilson Company</td>
<td>$115.00</td>
</tr>
<tr>
<td>10/8/03</td>
<td>Motorized liquid limit machine</td>
<td>Gilson Company</td>
<td>$606.00</td>
</tr>
<tr>
<td>10/22/03</td>
<td>Constant Temp. Bath Economy</td>
<td>Gilson Company</td>
<td>$2,544.00</td>
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<tr>
<td>10/22/03</td>
<td>Neoprene Holder for Al VacViscom</td>
<td>Gilson Company</td>
<td>$14.15</td>
</tr>
<tr>
<td>10/21/03</td>
<td>Electric Penetrometer</td>
<td>Gilson Company</td>
<td>$42.00</td>
</tr>
<tr>
<td>10/21/03</td>
<td>Support Shelf for MA-72</td>
<td>Gilson Company</td>
<td>$41.00</td>
</tr>
<tr>
<td>10/21/03</td>
<td>Plastic Transfer Disk</td>
<td>Gilson Company</td>
<td>$38.00</td>
</tr>
<tr>
<td>10/21/03</td>
<td>30z. Tinned steel can 2.1&quot;</td>
<td>Gilson Company</td>
<td>$9.00</td>
</tr>
<tr>
<td>10/21/03</td>
<td>6 oz Tinned steel can 2.8&quot;</td>
<td>Gilson Company</td>
<td>$12.00</td>
</tr>
<tr>
<td>10/21/03</td>
<td>Stopwatch, Digital</td>
<td>Gilson Company</td>
<td>$34.50</td>
</tr>
<tr>
<td>10/21/03</td>
<td>Sand equivalent shaker</td>
<td>Gilson Company</td>
<td>$2,160.00</td>
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<tr>
<td>10/21/03</td>
<td>Sand equivalent test set</td>
<td>Gilson Company</td>
<td>$305.00</td>
</tr>
<tr>
<td>10/21/03</td>
<td>Accessory set for liquid &amp; plastic limits</td>
<td>Gilson Company</td>
<td>$145.00</td>
</tr>
<tr>
<td>10/21/03</td>
<td>Grooving tool, AASHTO</td>
<td>Gilson Company</td>
<td>$30.00</td>
</tr>
<tr>
<td>10/21/03</td>
<td>Plastic Limit roller</td>
<td>Gilson Company</td>
<td>$130.00</td>
</tr>
<tr>
<td>10/21/03</td>
<td>SS wire basket fpr SG-6</td>
<td>Gilson Company</td>
<td>$75.50</td>
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<tr>
<td>11/13/03</td>
<td>Dig Recirc.HTG/Cool Bath</td>
<td>Gilson Company</td>
<td>$2,825.00</td>
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<tr>
<td>12/22/03</td>
<td>Rechargeable battery pack Vio F Series Sony CPU</td>
<td>PC Mall</td>
<td>$249.99</td>
</tr>
<tr>
<td>12/15/03</td>
<td>Sony Viao - S0130072277</td>
<td>PC Mall</td>
<td>$3,479.00</td>
</tr>
<tr>
<td>1/21/04</td>
<td>Mouse for Notebook</td>
<td>PC Mall</td>
<td>$49.99</td>
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<tr>
<td>1/26/04</td>
<td>DANAHER Controls</td>
<td>PC Mall</td>
<td>$351.75</td>
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<tr>
<td>1/26/04</td>
<td>Labview Base Pkg. for Windows NT</td>
<td>National Instruments</td>
<td>$664.95</td>
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<tr>
<td>1/29/04</td>
<td>Linksys PCMPC200</td>
<td>PC Connection,Inc.</td>
<td>$3,896.08</td>
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<tr>
<td>2/8/04</td>
<td>Lab. Equipment</td>
<td>Artech/Teto</td>
<td>$303.33</td>
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<tr>
<td>2/21/04</td>
<td>Carrying Case</td>
<td>PC Mall</td>
<td>$136.39</td>
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<tr>
<td>3/9/04</td>
<td>Plex</td>
<td>Plastic Unlimited</td>
<td>$117.62</td>
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<td>3/9/04</td>
<td>1-Port,Windows NT</td>
<td>National Instruments</td>
<td>$230.90</td>
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<tr>
<td>4/13/04</td>
<td>Wall Steel Tubing</td>
<td>Peterson Steel Corp.</td>
<td>$384.00</td>
</tr>
<tr>
<td>4/28/04</td>
<td>HM-2</td>
<td>Gilson Company</td>
<td>$2,148.00</td>
</tr>
<tr>
<td>4/28/04</td>
<td>Cable</td>
<td>Gilson Company</td>
<td>$19.91</td>
</tr>
<tr>
<td>3/22/04</td>
<td>Ethernet Cart</td>
<td>Staples</td>
<td>$52.47</td>
</tr>
<tr>
<td>3/22/04</td>
<td>Danaher Controls RS485</td>
<td>Staples</td>
<td>$83.50</td>
</tr>
<tr>
<td>3/26/00</td>
<td>150 MM Mold Assembly Perf.</td>
<td>Pine Instrument Co.</td>
<td>$3,208.12</td>
</tr>
<tr>
<td>4/13/04</td>
<td>Computer Equip./Lab Photos</td>
<td>Matt Teto</td>
<td>$131.77</td>
</tr>
<tr>
<td>4/13/04</td>
<td>Wall Steel Tubing</td>
<td>Peterson Steel Corp.</td>
<td>$384.00</td>
</tr>
<tr>
<td>4/13/04</td>
<td>HM-2</td>
<td>Gilson Company</td>
<td>$2,148.00</td>
</tr>
<tr>
<td>5/5/04</td>
<td>1 1/2&quot;x7&quot;x14 PVC</td>
<td>Plastic Unlimited</td>
<td>$58.33</td>
</tr>
<tr>
<td>5/11/04</td>
<td>Nylon Type 6 Cast 8&quot;Dia x 39&quot; L</td>
<td>Plastic Unlimited</td>
<td>$667.81</td>
</tr>
<tr>
<td>5/13/04</td>
<td>1 1/2&quot;x7&quot;x14 PVC</td>
<td>Plastic Unlimited</td>
<td>$55.78</td>
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<tr>
<td>5/18/00</td>
<td>4oz. Plastic &amp;##33</td>
<td>Plastic Unlimited</td>
<td>$10.39</td>
</tr>
<tr>
<td>6/7/04</td>
<td>Centrifuge Exractor</td>
<td>Gilson Company</td>
<td>$2,183.12</td>
</tr>
<tr>
<td>7/26/04</td>
<td>Trap Inlet Chemical ITC20K</td>
<td>BOC Edwards</td>
<td>$481.67</td>
</tr>
<tr>
<td>8/8/04</td>
<td>E-LAB2 Pump</td>
<td>BOC Edwards</td>
<td>$1,515.57</td>
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<tr>
<td>8/3/04</td>
<td>Lab. Supplies</td>
<td>Cole-Parmer</td>
<td>$218.03</td>
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<tr>
<td>9/2/04</td>
<td>Lab. Supplies</td>
<td>Cole-Parmer</td>
<td>$189.39</td>
</tr>
<tr>
<td>9/26/04</td>
<td>Valve</td>
<td>Cambridge Valve</td>
<td>$321.68</td>
</tr>
<tr>
<td>10/18/04</td>
<td>Steel Flat</td>
<td>Peterson Steel Corp.</td>
<td>$58.00</td>
</tr>
<tr>
<td>7/14/04</td>
<td>10_AU-005 Field Fluorometer</td>
<td>Turner Design, Inc.</td>
<td>$3,500.00</td>
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<tr>
<td>7/26/04</td>
<td>GOPS Beacon</td>
<td>Maine Tech. Sci.</td>
<td>$15,707.66</td>
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<tr>
<td>3/23/04</td>
<td>Carry 50 Scanning</td>
<td>Varian</td>
<td>$9,417.80</td>
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<td>5/5/04</td>
<td>ALS Interface Board</td>
<td>Agilent Tech.</td>
<td>$30,391.17</td>
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<tr>
<td>9/14/04</td>
<td>Atomic Absorption</td>
<td>Perkin Elmer</td>
<td>$41,388.83</td>
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<tr>
<td>12/10/00</td>
<td>Environmental Centrifuge</td>
<td>VWR</td>
<td>$2,665.00</td>
</tr>
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</table>

Total: $499,997.33
Appendix II

Additional Equipment Purchases
<table>
<thead>
<tr>
<th>Equipment Name</th>
<th>Vendor</th>
<th>Cost</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOC Analyzer</td>
<td>Shimadzu</td>
<td>$28,000</td>
<td>Jan-00</td>
</tr>
<tr>
<td>Particle Counter</td>
<td>Chemtrac</td>
<td>$8,500</td>
<td>Jul-00</td>
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<tr>
<td>Water Purification System</td>
<td>Millipore</td>
<td>$12,000</td>
<td>Jul-00</td>
</tr>
<tr>
<td>Tenius Olsen Retrofit (partial)</td>
<td>Instrom</td>
<td>$20,000</td>
<td>Jan-00</td>
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<tr>
<td>Environmental Refrigerator Unit</td>
<td>Fisher</td>
<td>$1,496</td>
<td>Oct-00</td>
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<tr>
<td>GC (partial)</td>
<td>Agilent Tech.</td>
<td>$12,178</td>
<td>Mar-00</td>
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<tr>
<td>Incubator</td>
<td>Fisher</td>
<td>$2,594</td>
<td>Feb-00</td>
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<tr>
<td>Laminar Flow Cleanbench</td>
<td>Cleanroom Filters</td>
<td>$2,898</td>
<td>Aug-00</td>
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<tr>
<td>Water Purification System</td>
<td>Barnstead</td>
<td>$4,500</td>
<td>Oct-00</td>
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<tr>
<td>Model Module Load Simulator</td>
<td>MLS Test Systems Co.</td>
<td>$85,000</td>
<td>Dec-00</td>
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<tr>
<td>Pavement Quality Indicator</td>
<td>Transtech Systems</td>
<td>$6,000</td>
<td>Mar-00</td>
</tr>
<tr>
<td>Computers for field work</td>
<td>PC Mall</td>
<td>$9,530</td>
<td>Mar-00</td>
</tr>
<tr>
<td>Software for statistical analysis</td>
<td>SAS Institute</td>
<td>$1,750</td>
<td>Mar-00</td>
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<td>Triaxial testing equipment</td>
<td>Shetworks Inc.</td>
<td>$51,678</td>
<td>Mar-00</td>
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<tr>
<td>10-AU-005 Fluorometer</td>
<td>Turner Design</td>
<td>$7,500</td>
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<tr>
<td>Vetronix.Com Corp.</td>
<td>CDR kit</td>
<td>$2,495</td>
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<tr>
<td>Cole-Parmer Instrument Co.</td>
<td>18X24 reconditioned cart</td>
<td>$109</td>
<td>Nov-04</td>
</tr>
<tr>
<td>Worcester County Welding</td>
<td>cut 8 holes in plates</td>
<td>$96</td>
<td>Nov-04</td>
</tr>
<tr>
<td>Instron</td>
<td>general purpose TUP</td>
<td>$4,386</td>
<td>Nov-04</td>
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<tr>
<td>Plastics Unlimited</td>
<td>1” sch 40 pipe, OD ID</td>
<td>$39</td>
<td>Nov-04</td>
</tr>
<tr>
<td>Grainger, Inc.</td>
<td>115V AC electric winch</td>
<td>$323</td>
<td>Nov-04</td>
</tr>
<tr>
<td>Peterson Steel Corp.</td>
<td>3” sch 40 carbon steel pipe 120”</td>
<td>$218</td>
<td>Nov-04</td>
</tr>
<tr>
<td>Peterson Steel Corp.</td>
<td>3” sch 40 carbon steel pipe 120”</td>
<td>$73</td>
<td>Nov-04</td>
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<tr>
<td>TechImaging Serv</td>
<td>MotionScope PCI 8000 Video Sys</td>
<td>$20,736</td>
<td>Nov-04</td>
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</tbody>
</table>

TOTAL $282,098
Appendix III

Positions Added to CEE Department
Research Secretary

**Basic Function**: Assist active researchers in the civil engineering department with report and proposal writing as well as budget and administrative record keeping. Perform a wide range of secretarial and administrative duties with limited supervision for a department head/director of a small department or second secretary in a department which has many faculty members or students. Perform/be able to perform most or all of the duties and responsibilities of the Administrative Secretary II level.

**Principal Duties**: Provide word processing of complex manuscripts, materials, reports, office forms and use several business software packages. Compose correspondence requiring exercising judgment and originality. Maintain complex calendars; screen calls; make appointments; handle arrangements for travel, meetings, conferences, etc. Review mail for content, taking initiative to answer some independently as appropriate. Assist with budget preparation and/or accounts maintenance; perform some bookkeeping and billing; reconcile discrepancies; process vouchers and personnel forms. Maintain and compile statistical data; prepare and format general spreadsheets, etc.; perform minor research or statistical analysis.

**Qualifications**: Existing skills, or the ability to learn skills in word processing (Word and Word Perfect), basic spreadsheet operations (Excel), e-mail communication (file transfer ... etc), and web page maintainance. Previous office experience and appropriate education.

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Laboratory Manager

**Basic Function**: Responsible for the overall efficient operation of all labs and stockrooms within the building. This manager works closely with all faculty, staff and students to help facilitate the academic and research goals of the Civil Engineering Department. The Civil Engineering Department presently has laboratory facilities for structures, geotechnical, impact, asphalt, environmental and material engineering testing. Much of this laboratory space had undergone major renovations during the summer of 2000, and has received over $0.5M of new equipment plus $0.5M in physical renovations.

**Principal Duties**: Coordinate all purchase order activity for all laboratories; maintain vendor files and contacts; solicit cost quotations, as necessary. Assist Department Head with financial management issues; monitor and report monthly budget activity; recommend and manage appropriate cost control methods. Act as the building liaison with Plant Services tradesmen and project managers for building repairs and renovations. Supervise all workstudy students, research assistants and teaching assistants involved with laboratory teaching and research activities. Perform all duties as assigned by the
Department Head. The lab manager will also support the academic interests of the
department through the following activities. He/she will:

Assume responsibility for care and maintenance of instrumentation in the civil
engineering laboratories.

Participate in proposal preparation, particularly for the upgrading of facilities.

Supervise and/or instruct in the undergraduate laboratory program.

**Qualifications:** Bachelors degree in science relate field preferred. Two to four years
business systems experience, preferably in higher education preferred. Must be able to
clearly recognize his/her role as a staff resource for the academic and research programs
in Kaven Hall and the entire campus community. Must be an effective communicator to
a very diverse community, and possess an adequate level of computer skills to support
this level of service.

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**Asphalt Research Engineer**

**Basic Function:** The basic function is coordination of laboratory work for sponsored
highway materials research and development of new test methods and equipment for
highway materials related problems in conjunction with Material Science and
Engineering department. The person will work with state Departments of Transportation,
aggregate suppliers, asphalt suppliers, HMA contractors, Federal Highway
Administration and others to identify materials related problems, work towards
implementation of a plan for accreditation of Highway Materials Laboratory by the
American Association of State Highway and Transportation Officials (AASHTO), and
oversee research work of a group of undergraduate students.

**Principal Duties:** Principal duties include procurement of materials, laboratory work
with asphalt materials, and supervision of laboratory work, data collection, and
upgrading/modification of existing and fabrication of new equipment in the asphalt
laboratory.

**Qualifications:** The minimum qualification required is a Bachelor's degree in Civil
Engineering with relevant coursework in highway materials, especially asphalt materials,
and experience of work in a highway materials production plant and highway
construction/research related fieldwork.
Appendix IV

Resumes of New Hires
Appendix V

Resumes of New Faculty
John Bergendahl, Ph.D, P.E.
Department of Civil and Environmental Engineering
Worcester Polytechnic Institute, Worcester, MA
Phone: (508) 831-5772; email: jberg@wpi.edu

Education

Doctor of Philosophy in Chemical Engineering, February 1999; University of Connecticut, Storrs, CT
  • Dissertation: Modeling the Mechanics of Colloid Detachment in Environmental Systems
  • Research in colloid and surface chemistry; application to physicochemical processes

Master of Science in Environmental Engineering, August 1996; University of Connecticut, Storrs, CT

Bachelor of Science in Mechanical Engineering, December 1985; University of Connecticut, Storrs, CT

Professional Experience

Assistant Professor, January 2000 – present; Department of Civil and Environmental Engineering, Worcester Polytechnic Institute, Worcester, MA
  Courses Taught:
  • Spring 2000, CE590F, Physical and Chemical Treatment Processes, Advanced Distance Learning Network course
  • Fall 2000, CE561, Advanced Principles of Wastewater Treatment, Advanced Distance Learning Network course

Postdoctoral Research Fellow, March 1999 – December 1999; Environmental and Water Resources Engineering Program, Department of Civil Engineering, University of Texas, Austin, TX
  • Research project: Stability and Mobility of Plutonium Colloids

Research Associate, 1995 - February 1999; University of Connecticut, Storrs, CT
  Research Projects:
  • Colloid Generation During Batch Leaching Tests. Quantification of increase in colloid concentrations during agitated batch tests, and exploration of detachment mechanisms
  • Colloid Detachment Mechanisms in Porous Media. Investigation on colloid detachment from porous media due to solution chemistry and hydrodynamic perturbations
  • Site Closure Criteria For Coal-Tar Contaminated Sites. Evaluation of the acceptability of EPA’s Toxicity Characteristic Leaching Procedure for hydrophobic organic contaminated soil
• **Fenton’s Oxidation of Chlorinated Solvents.** Study to evaluate the feasibility of using Fenton’s reagent oxidation to treat solvent contaminated groundwater at a Superfund site.

• **Evaluation of Zero Valent Iron Reactive Wall at Dover Air Force Base, Dover Delaware – Study of Inorganic Colloids.**

Teaching Fellow, 1993 – February 1999; University of Connecticut, Storrs, CT

• Instructor for Environmental Engineering Chemistry (Graduate), Fall 1998

• Provide guidance to students in the following classes: Introduction to Engineering, Unit Operations in Water Quality Engineering, Chemical Engineering Laboratory, Water Purification Principles, and Environmental Engineering Chemistry

• Lectured in: Environmental Engineering Chemistry, Introduction to Engineering, Water Quality Engineering, and Environmental Engineering Laboratory


• Conducted site audits and suggestions on pollution prevention opportunities for industry

• Evaluated process changes to reduce hazardous material generation

Senior Engineer, Engineer, Associate Engineer, 1985 - 1992; General Dynamics, Electric Boat Div., Groton, CT

• Fluid system and component design projects

• Responsibilities included: conceptual development, design calculations, material and component selection, presenting customer design reviews, and engineering support for manufacturing

• Cognizant engineer for: seawater systems, freshwater systems, lube and fuel oil systems, miscellaneous pumps, hoses, filters, etc.

**Publications**

**Journal Articles**


Presentations

Thermodynamics and Hydrodynamics of Colloid Detachment in a Model Porous Media, American Institute of Chemical Engineers Annual Meeting, Interfacial Aspects of Remediation Technology, Dallas, Texas, November 5, 1999, with D. Grasso.

Poster Presentation: Plutonium Colloid Mobility and Stability, Environmental Solutions Program, University of Texas, Austin, TX, November 4, 1999, with S. Aghara, L. Katz, D. Lawler, and S. Landsberger.


Mechanisms of Colloid Detachment in Porous Media, Department of Civil and Environmental Engineering, University of Michigan, Ann Arbor, MI, November 23, 1998.


Mechanisms of Colloid Detachment in Environmental Systems, Northeast Regional Student Environmental Conference, University of Massachusetts, April 18, 1998.


Quantification of PAH Concentrations During the Toxicity Characteristic Leaching Procedure, Department of Civil and Environmental Engineering, University of Connecticut, Storrs, CT, November 1, 1996.

Reports


Patent

Centrifugal Method to Separate Particles from Granular Media; patent applied for: application #09/671968, dated 9/29/2000

Funding

Oxidation Reduction Potential versus Residual Control of Chlorine, Damon S. Williams Associates / Water Environment Research Foundation, $29,279

Field Testing Fenton’s Oxidation at SRSNE, de maximis, inc., $59,007 (with D. Grasso, Smith College, verbally accepted)

Effect of Hydrogeology and Water Quality on Inorganic and Protozoan Particle Mobilization in Riverbank Filtration, U.S. Environmental Protection Agency, $518,632 (with D. Grasso, Smith College, pending)

Colloid-Facilitated Leaching of Hydrophobic Contaminants, American Chemical Society Petroleum Research Fund, $25,000 (pending)

Reviewer

Prentice Hall, College Division (Textbook)

Environmental Toxicology and Chemistry

Water Research

Environmental Science and Technology

Journal of Soil and Sediment Contamination


1st World Congress of the International Water Association (IWA): Paris 2000, Paper Referee

Professional Licensure

Professional Engineer, State of Connecticut
Honors and Fellowships

U.S. Department of Defense Fellowship, 1997 - 1998, Environmental Fellowship Program
Inducted member *Chi Epsilon*, National Civil Engineering Honor Society
Inducted member of the Honor Society of *Phi Kappa Phi*
University of Connecticut, Summer 1996 Fellowship for Advanced Graduate Students

**University of Connecticut, Pollution Prevention Research and Development Center Fellowship, 1993 - 1994**

Service

ASCE Hazardous Waste Committee member (Environmental Engineering Division), 1998 - present
Resident Assistant for Graduate Residences; January 1997 - January 1999, University of Connecticut
University of Connecticut Resident Assistant Advisory Committee, 1998
UCONN CONNECTS Facilitator; 1997 - 1999, Mentor for academic intervention program at the University of Connecticut for students on probation
Connecticut Science Fair Judge, 1998

Professional Affiliation

American Chemical Society; American Institute of Chemical Engineers;
American Society of Civil Engineers; Association of Environmental Engineering Professors
JEANINE D. PLUMMER
Assistant Professor
Department of Civil and Environmental Engineering
100 Institute Road
Worcester Polytechnic Institute
Worcester, MA 01609
Phone: (508) 831-5142; Fax: (508) 831-5808; e-mail: jplummer@wpi.edu

PROFESSIONAL PREPARATION

Cornell University Civil and Environmental Engineering B.S., 1993
University of Massachusetts Environmental Engineering M.S., 1995
University of Massachusetts Civil and Environmental Engineering Ph.D., 1999

APPOINTMENTS

Worcester Polytechnic Institute Assistant Professor 8/99 – present
Teaching undergraduate and graduate courses in environmental engineering, water treatment processes, and water chemistry. Research interests include control of algae in water supplies; disinfection byproduct production from algae; microbial contamination of water supplies; and physical and chemical treatment processes.

PUBLICATIONS

Plummer, J. D. 1999. Control of Algae in Drinking Waters by Coagulation and Oxidation. Ph.D. Dissertation, Department of Civil and Environmental Engineering, University of Massachusetts at Amherst, MA.
Plummer, J. D. 1995. Removal of Cryptosporidium parvum from Drinking Water by Dissolved Air Flotation. Master's Thesis, Department of Civil and Environmental Engineering, University of Massachusetts at Amherst, MA.

PRESENTATIONS/PROCEEDINGS PUBLICATIONS


**AWARDS, HONORS and FELLOWSHIPS**

- U.S. Environmental Protection Agency STAR Graduate Fellowship 1996-1999
- United Technologies Outstanding Graduate Woman in Engineering Award 1996
- Association of Environmental Engineering Professors/Montgomery-Watson Master's Thesis Award: First Place 1995
- National Science Foundation Graduate Research Fellowship 1993-1996

**PROFESSIONAL EXPERIENCE**

- **Institute Assistant**  
  *Dr. J. K. Edzwald, Institute Director*  
  1995-1998  
  Institute in Drinking Water Treatment, sponsored by the Environmental Engineering Program at the University of Massachusetts. Assisted Institute Director with institute management, logistics and laboratory demonstrations.

- **Research Assistant**  
  *Dr. C. A. Shoemaker, Cornell University*  
  6/92 - 5/93  
  Investigated method to correct groundwater remediation strategies given model prediction errors. Performed computer simulations of contaminant movement in
aquifers undergoing clean-up and analyzed results. Developed FORTRAN programs.

Technician  
_Sverdrup Corporation, Boston, MA_  
9/91 - 1/92
Designed and evaluated seventy culverts for drainage beneath commuter railroad. Provided quantity estimates for ten-pier railroad bridge. Edited five technical reports and specifications for submittal to clients.

PROFESSIONAL AFFILIATIONS

American Society of Civil Engineers
American Water Works Association  
Member, Particulate Contaminants Research Committee (AWWA), 2000
Association of Environmental Engineering and Science Professors
International Water Association
New England Water Works Association

JOURNAL REVIEWER

Ozone Science and Engineering - The Journal of the International Ozone Association
Journal of Water Supply: Research and Technology - AQUA
Appendix VI

Photos of New Lab Facilities
Appendix VII

Recent Proposals
<table>
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<tr>
<th>Project Title</th>
<th>Faculty</th>
<th>Sponsor</th>
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<tr>
<td>Theoretical Investigation of Colloid Detachment Using Molecular Dynamics Simulations</td>
<td>J. Bergendahl</td>
<td>ACS</td>
<td>$25,000</td>
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<td>Effect of Hydrogeology and Water Quality on Inorganic and Protozoan Particle Mobilization in Riverbank Filtration</td>
<td>J. Bergendahl</td>
<td>EPA</td>
<td>$518,632</td>
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<td>Field Testing of Fenton's Oxidation at SRSNE</td>
<td>J. Bergendahl</td>
<td>de maximis</td>
<td>$51,000</td>
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<tr>
<td>Non-Destructive Measurement of Pavement Layer Thickness</td>
<td>R. Mallick</td>
<td>Infrasense</td>
<td>$20,041</td>
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<td>Evaluation of Permeability of Superpave Mixes In ME</td>
<td>R. Mallick</td>
<td>MEDOT</td>
<td>$3,317</td>
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<td>Development of a Fast and Effective Method for</td>
<td>R. Mallick</td>
<td>NSF</td>
<td>$375,000</td>
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<td>Evaluation of Aggregate Properties</td>
<td>R. Mallick</td>
<td>NAS</td>
<td>$97,342</td>
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<td>Development of Warm Mix Asphalt</td>
<td>R. Mallick</td>
<td>NAS</td>
<td>$93,765</td>
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<td>Development of Warm Mix Asphalt</td>
<td>R. Mallick</td>
<td>NAS</td>
<td>$86,474</td>
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<td>Career:Understanding the Effect of Materials and Mix Properties on Long-Term Performance of Full Depth Reclam</td>
<td>R. Mallick</td>
<td>NSF</td>
<td>$375,000</td>
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<td>Development of a Non-Destructive Testing System for Evaluation of Foundation Soil</td>
<td>R. Mallick</td>
<td>NSF</td>
<td>$177,843</td>
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<td>Relationships of HMA In-Place Air Voids, Lift Thickness, and Permeability</td>
<td>R. Mallick</td>
<td>Purdue</td>
<td>$111,773</td>
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<td>Field Evaluation of Use of Manufactured Waste Asphalt Shingles in Hot Mix Asphalt</td>
<td>R. Mallick</td>
<td>UMA Amherst</td>
<td>$45,971</td>
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<td>Evaluation of Asphaltic Expansion Joints</td>
<td>R. Mallick</td>
<td>UMA Dartmouth</td>
<td>$29,943</td>
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<td>Evaluation of Permeability of Superpave Mixes</td>
<td>R. Mallick</td>
<td>UMA Dartmouth</td>
<td>$49,723</td>
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<td>Hydrology of the Jones River Watershed</td>
<td>P. Mathisen</td>
<td>ARL</td>
<td>$24,661</td>
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<td>Modeling the Bacteriological Impact of Livestock on Water Quality Using GIS</td>
<td>P. Mathisen</td>
<td>USDA</td>
<td>$206,977</td>
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<tr>
<td>Career: Rational Strategies for Control of Algae in Drink Waters</td>
<td>J. Plummer</td>
<td>NSF</td>
<td>$375,000</td>
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<td>Powre: Removal of Algal DBP Precursors by Coagulation</td>
<td>J. Plummer</td>
<td>NSF</td>
<td>$69,247</td>
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<td>Modeling the Bacteriological Impact of Livestock on Water Quality Using GIS</td>
<td>J. Plummer</td>
<td>USDA</td>
<td>$206,977</td>
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<td>Application Context-Sensitive Design Principles</td>
<td>M. Ray</td>
<td>NAS</td>
<td>$125,000</td>
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<td>CCLI: Prototype Educational Materials Development for an Impact Mechanics Course</td>
<td>M. Ray</td>
<td>NSF</td>
<td>$73,009</td>
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Appendix VIII

Recent Publications
Refereed


Mathisen, P., “Use Of A Graduate-Level Distance Learning Course To Enhance Undergraduate Education In Civil Engineering: A Combined Graduate/Undergraduate Course In Hydrology” Proceedings of the 1999 Annual Meeting of the American Society of Engineering Education (ASEE), June 1999 in Charlotte, NC.


**Non-refereed**


M. H. Ray, Cutting the High-Cost of Crash Testing, In Civil Engineering, American Society of Civil Engineering (ASCE), August 1999.


Mallick, R., Prithvi S. Kandhal “Testing of Hot Mix Asphalt (HMA) with the Asphalt Pavement Analyzer”, Presented And Published at the International Conference on Accelerated Pavement Testing in Reno, October, 1999.


Appendix IX

Recent Presentations


Mallick, R., “Use of shingles in hot mix asphalt,” Bardon Trimount Inc., Saugus, MA, September, 1999

Mallick, R., “Evaluation of rutting potential of mixes with the APA,” Pike Industries, Belmont, NH, September, 1999

Mallick, R., “Cooperation Of Industry And Academic Institutions For Building A Research And Education Program On Asphalt Materials,” Massachusetts Aggregate and Asphalt Pavement Association (MAAPA) Board Meeting, Marlboro, MA, October, 1999

Mallick, R., “Opportunities of research at WPI,” New Hampshire Department of Transportation, Concord, NH, October, 1999

Mallick, R., “Development Of In-Place Permeameter For Hot Mix Asphalt,” Maine Department of Transportation, Augusta, ME, October, 1999.


Mathisen, P., “Use Of A Graduate-Level Distance Learning Course To Enhance Undergraduate Education In Civil Engineering: A Combined Graduate/Undergraduate Course In Hydrology,” Presented At The 1999 Annual Meeting of the American Society of Engineering Education (ASEE), scheduled for June 1999 in Charlotte, NC.

Roberge, J and P. Mathisen, “Sensitivity Analyses To Assess The Use Of CFD For Predicting The Occurrence Of Swirl In Pump Intakes,” Presented At The Symposium on


Ray, M. H., Invited Speaker, In-Service Performance of Traffic Barriers, Transportation Research Board, Roadside Safety Features Committee Summer Meeting, Estes Park, CO,


Ray, M. H., Presentation to Transportation Engineering Seminar, In-Service Evaluation of Traffic Barriers, University of Massachusetts, Amherst, MA, 14 October 1999.


Ray, M. H., Presentation to WPI Board of Trustees, Crashworthiness and Impact Analysis, WPI Advisory Board Meetings, Worcester, MA, 28 October 1999.


Appendix X

EIP Distance Learning Program