**IMPROVE Steering Committee Meeting Summary**  
*August 18, 1987*

**Introduction**
An IMPROVE Steering Committee meeting was held August 18, 1987, at the Federal Building in downtown Denver, CO.

David Dietrich and John Molenar of Air Resource Specialists, Inc. of Ft. Collins, and Thomas Cahill of the University of California at Davis were available for part of the meeting to brief the steering group on the deployment and operation of the IMPROVE visibility and particle monitoring systems.

The primary objective of the meeting was to review the status of the deployment and operations of the long-term monitoring network and the impairment monitoring efforts. Also discussed were the status of participant agencies’ activities related to visibility and an update on IMPROVE action items.

**Monitoring Status** (some of the following was received since the meeting)
The optical monitoring at the long-term sites will ultimately consist of transmissometers and cameras. At this point in time all of the cameras except the one in Denali NP have been installed and are operational. Until transmissometers are installed at the sites, the cameras are directed at suitable contrast measurement targets and extinction coefficient is derived from the slide in a manner analogous to the teleradiometer approach. As of the meeting, transmissometers were operational at Canyonlands NP, and Grand Canyon NP. The next 11 transmissometers are scheduled for installation during this fall and winter. An anticipated schedule for installation is Table 2.1 of attachment A (distributed by David Dietrich at the meeting). It should be noted that at the time of the meeting the NPS was in process of competitive procurement for the needed extinction coefficient monitoring instrumentation. Since that time the procurement has been competed with Aerovironment’s Long Range Transmissometer, the selected instrument.

The startup of IMPROVE particle samplers in the long-term network is scheduled during the first 10 days of October (see the attachment B, the Sept. 17th letter from UCD). Many of the samplers had already been deployed by the time of the meeting. The decision to not start each of them upon deployment was necessary to save the high cost of sample analysis for the earliest deployed samplers. During the meeting Thomas Cahill briefed the Steering Committee on the sampler and its performance during the SCENES winter study (WHITEX). The sampler performed exceptionally well. The experience gained with the sampler in WHITEX and other field trials is being used to make minor adjustments in the instrument and to improve the standard operating procedures to be used by field personnel. (Attachment C is the third progress report from UCD distributed at the meeting).

The committee was made aware of possible problems with the deployment of a few of the sites. These primarily consisted of finding locations that allowed winter access at several of the selected Class I areas. The contractors were uncertain how they were to proceed under such circumstances. The following guidance was agreed upon:
1) the contractor, in consultation with the local FLM, is responsible for finding a technically suitable all-season site in or near the specified Class I area;

2) if that is not possible, the contractor will notify the NPS contract task monitor of the problem and his recommendation;

3) it is NPS’s responsibility to either find a nearby Class I area without the problem, or to choose to operate seasonally (in either case NPS will notify the steering committee); and

4) if that is not reasonable, NPS will recommend to the steering committee that they select some altogether different location.

It is NPS’s responsibility to coordinate among the contractors (ARS and UCD) and the FLM’s concerning use of alternate sites or seasonal operation.

Photography at Petrified Forest NP and Voyageurs NP has been conducted for six and nine months respectively (as of the meeting) in an effort to document so-called reasonably attributable impairment (in these cases impairment is thought to come from nearby known emission sources). As of the meeting there were no plumes or elevated layers seen in the photographs from these locations. The Steering Committee decided to continue operations at least until twelve months of photos are collected and evaluated before making a decision to continue or not. A request was made to expand this effort to Moosehorn Wilderness where plumes form a nearby source are thought to impact. A camera was sent to them at the end of August 1987 so that they could begin operations.

**Status of Participant’s Visibility Activities**

There are now three lawsuits against EPA concerning visibility. They are intended to (1) force EPA to develop a strategy to cope with regional haze impacts on protected Class I areas, (2) have EPA develop a fine particle secondary standard with visibility as the primary welfare basis for the standard, and (3) reverse EPA’s decision to ignore the out-of-state SO$_2$ emissions limits that were requested by the State of Vermont in the visibility provisions of their state implementation plan.

EPA’s Office of Air Quality Planning and Standards is undergoing a reorganization which will have some influence on who in the organization will be concerned with visibility. Separate from this reorganization, a task-force has been established within OAQPS to work on visibility and fine particle issues. Bruce Polkowsky will head the task-force which will include representatives from the various organizational units within OAQPS that have a role to play in visibility. Thomas Pace has been assigned to take Janet Metsa’s place on the task-force including her work with the IMPROVE program. (Janet, who is about to start an extended leave-of-absence, will be missed by those of us who remain).

EPA has established a Visibility Research Subcommittee of the Clean Air Science Advisory Committee to review and comment on EPA’s visibility research programs. The VRS will hold public meetings to receive input from those groups that conduct or have an interest in visibility research. The first meeting is anticipated for early in calendar year 1988.
FS has approval for a plan to substantially increase the size of their air quality/visibility programs nationwide for fiscal year 1990. The manpower and fiscal resources for this would be distributed to the FS regional offices. How this will impact the FS participation in IMPROVE remains to be seen.

NPS’s Air Quality Office in Denver has physically moved to a new address (shown below). The NPS regional offices are expected to have a greater influence on air quality monitoring priorities within the NPS. This is not anticipated to impact their participation in the IMPROVE Program.

12795 West Alameda Parkway  
PO Box 25287  
Lakewood, CO 80225

**Update on Selected Action Items**

The NPS tasked Desert Research Institute to devise procedures that would be used to document visibility impairment in protected areas and attribute the impairment to pollution sources. David Joseph and Marc Pitchford reported on a planning meeting for this effort with John Watson and Thomas Hoffer of DRI. The outputs from this work will include (1) a questionnaire with detailed instructions for use by FLM field personnel to document visibility impairment; (2) a three level approach for attribution of the impairment to sources, the first level uses qualitative interpretation of available data, the second requires more elaborate analysis of available data, the third level involves the gathering of additional data required for the source attribution; and (3) a discussion of methods to relate changes in pollution emissions to changes in visibility. A draft of the output is anticipated from DRI before the end of the calendar year.

David Joseph briefed the Steering Committee on work in progress at SAI to catalog and critique all available air quality simulation models that are applicable to visibility issues. A résumé will be prepared for each model which will include model strengths and weaknesses, cost, capability to analyze alternative control measures, and availability of model output for computer imaging.

The Steering Committee discussed the need for a monitoring guidance document that could be used to aid groups that have a need to monitor visibility protected areas. It could be patterned after the IMPROVE Program monitoring protocols. Also discussed was the long overdue IMPROVE annual report. Little or no progress has been made in completing it.

-- end --
**IMPROVE Steering Committee Meeting Agenda**

**Dates:** August 18, 1987  
**Location:** Room #1083 of the Federal Building  
19th and Stout Streets, downtown Denver, CO

<table>
<thead>
<tr>
<th>August 18</th>
<th>Time</th>
<th>Agenda Item</th>
<th>Presenter(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9:00 am</td>
<td>Update on EPA activities: Vermont lawsuit, OAQPS reorganization, SAB, FY88 funds for IMPROVE, eastern visibility network</td>
<td>David Stonefield and Marc Pitchford</td>
</tr>
<tr>
<td></td>
<td>10:00 am</td>
<td>Update on NPS activities: Contract efforts on modeling and on existing impairment, WHITEX, impairment monitoring at selected Class I areas, air office relocation, dry deposition network</td>
<td>David Joseph and William Malm</td>
</tr>
<tr>
<td></td>
<td>11:00 am</td>
<td>Updates on FS, FWS, &amp; BLM activities</td>
<td>Richard Fisher, Bud Rolofson, and Scott Archer</td>
</tr>
<tr>
<td></td>
<td>12:00 pm</td>
<td>Lunch</td>
<td></td>
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<tr>
<td></td>
<td>1:30 pm</td>
<td>Long-term network deployment and operations: overview, particle samplers, sample analysis, intercomparison testing, optical monitoring, data handling and reporting, quality assurance, IMPROVE look-alike sites</td>
<td>William Malm and UCD and ARS representatives</td>
</tr>
<tr>
<td></td>
<td>3:00 pm</td>
<td>Break</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3:15 pm</td>
<td>Remaining old business</td>
<td>Marc Pitchford</td>
</tr>
<tr>
<td></td>
<td>3:30 pm</td>
<td>New business</td>
<td>Marc Pitchford</td>
</tr>
<tr>
<td></td>
<td>3:45 pm</td>
<td>Adjourn</td>
<td></td>
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</table>
## IMROVE Steering Committee Meeting Participants

### August 18, 1987

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>William Malm</td>
<td>NPS, Ft. Collins, CO</td>
<td>303 491-8292</td>
</tr>
<tr>
<td>Daivd Joseph</td>
<td>NPS, Denver, CO</td>
<td>FTS 327-2071</td>
</tr>
<tr>
<td>Brian Mitchell</td>
<td>NPS, Denver, CO</td>
<td>FTS 327-2071</td>
</tr>
<tr>
<td>Bud Rolofson</td>
<td>FWS, Denver, CO</td>
<td>FTS 327-2071</td>
</tr>
<tr>
<td>James Byrnes</td>
<td>FS, Washington, DC</td>
<td>FTS 235-8096</td>
</tr>
<tr>
<td>Richard Fisher</td>
<td>FS, Ft. Collins, CO</td>
<td>FTS 323-1232</td>
</tr>
<tr>
<td>Scott Archer</td>
<td>BLM, Denver, CO</td>
<td>FTS 776-1762</td>
</tr>
<tr>
<td>David Stonefield</td>
<td>EPA, Durham, NC</td>
<td>FTS 629-5540</td>
</tr>
<tr>
<td>Marc Pitchford</td>
<td>EPA, Las Vegas, NV</td>
<td>FTS 545-2363</td>
</tr>
<tr>
<td>Site Abrev.</td>
<td>Site Name</td>
<td>Cameras (Auto 35mm)</td>
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<td>------------</td>
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<td>---------------------</td>
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<tr>
<td>1</td>
<td>ACAD Acadia National Park</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>BIBE Big Bend National Park</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>BRID Bridger Wilderness</td>
<td>1</td>
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<tr>
<td>4</td>
<td>BRCN* Bryce Canyon National Park</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>CANY Canyonlands National Park</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>CHIR Chiricahua National Park</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>CRLA Crater Lake National Park</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>DENA Denali National Park</td>
<td></td>
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<tr>
<td></td>
<td></td>
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<tr>
<td>9</td>
<td>GLAT Glacier National Park</td>
<td>2</td>
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<tr>
<td>10</td>
<td>GRCT* Grand Canyon National Park</td>
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<tr>
<td>11</td>
<td>GRSM Great Smokey Mountains Park</td>
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<tr>
<td>12</td>
<td>JARB Jarbridge Wilderness</td>
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<tr>
<td>13</td>
<td>MEVE Mesa Verde National Park</td>
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<tr>
<td>14</td>
<td>MORA Mount Rainier National Park</td>
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<td>15</td>
<td>ROMM Rocky Mountain National Park</td>
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<tr>
<td>16</td>
<td>SAGO San Gorgonio Wilderness</td>
<td>1</td>
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<tr>
<td>17</td>
<td>SHEN Shenandoah National Park</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>SUPE Superstition Wilderness</td>
<td>1</td>
</tr>
<tr>
<td>19</td>
<td>WEMI Weminuche Wilderness</td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>YOSW Yosemite National Park</td>
<td>1</td>
</tr>
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* Also SCENES Sites
### Table 2-1
Transmissometer Installation Schedule
April 87 - March 88

<table>
<thead>
<tr>
<th>Location</th>
<th>Network</th>
<th>Site Visit (Selection)</th>
<th>Installation</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canyonlands</td>
<td>I</td>
<td></td>
<td>12/20/86</td>
<td></td>
</tr>
<tr>
<td>Petrified Forest</td>
<td>P</td>
<td>04/18/87</td>
<td>Re-installed 7/6-7/10/87</td>
<td></td>
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<tr>
<td>Grand Canyon</td>
<td>I</td>
<td>12/20/86</td>
<td>Re-installed 7/13-7/17/87</td>
<td></td>
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<tr>
<td>Shenendoah</td>
<td>I</td>
<td>6/15</td>
<td>October</td>
<td>Awaiting Environmental Assessment/Approval</td>
</tr>
<tr>
<td>Rocky Mountain</td>
<td>I</td>
<td>7/13</td>
<td>8/17-8/21</td>
<td>Sheltering and Power Only</td>
</tr>
<tr>
<td>Yellowstone/Grand Teton</td>
<td>P</td>
<td>7/20</td>
<td>September</td>
<td>Awaiting Installation Approval</td>
</tr>
<tr>
<td>Glacier</td>
<td>I</td>
<td>8/17</td>
<td>October</td>
<td></td>
</tr>
<tr>
<td>Mount Rainier</td>
<td>I</td>
<td>9/9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voyageurs</td>
<td>P</td>
<td>8/3</td>
<td>September</td>
<td>Awaiting Installation Approval</td>
</tr>
<tr>
<td>Acadia</td>
<td>I</td>
<td>September</td>
<td>October</td>
<td></td>
</tr>
<tr>
<td>Great Smokey Mtns.</td>
<td>I</td>
<td>September</td>
<td>October</td>
<td></td>
</tr>
<tr>
<td>Badlands</td>
<td>P</td>
<td>October</td>
<td>November</td>
<td></td>
</tr>
<tr>
<td>San Gorgonio</td>
<td>I</td>
<td>October</td>
<td>November</td>
<td></td>
</tr>
<tr>
<td>Pinnacles</td>
<td>P</td>
<td>October</td>
<td>December</td>
<td></td>
</tr>
<tr>
<td>Superstition</td>
<td>I</td>
<td>7/16</td>
<td>January(88)</td>
<td>Approval for Installation Underway</td>
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<tr>
<td>Chiricahua</td>
<td>I</td>
<td>January(88)</td>
<td>February(88)</td>
<td></td>
</tr>
<tr>
<td>Carlsbad</td>
<td>P</td>
<td>January(88)</td>
<td>February(88)</td>
<td></td>
</tr>
<tr>
<td>Big Bend</td>
<td>I</td>
<td>January(88)</td>
<td>March(88)</td>
<td></td>
</tr>
<tr>
<td>Mesa Verde</td>
<td>I</td>
<td>February(88)</td>
<td>March(88)</td>
<td></td>
</tr>
</tbody>
</table>

1 Network Key: I = IMPROVE, P = Non-IMPROVE to be operated according to IMPROVE protocol.

2 After review of initial data, it was decided to shorten the sight path at Petrified Forest. The site was re-installed during July 6-10, 1987.

3 It is likely that the transmissometer site will be installed in Grand Teton National Park.
Transmissometer Site Selection
Task and Equipment Checklist

Unit Name: ____________________________  Technician: ____________________________

Date: ________________________________

I. SITE SELECTION TASKS

A. Site Contacts

1. Administrative Contacts: Name ____________________________
   Address ____________________________
   Telephone ____________________________

2. Site Operator
   Name ____________________________
   Address ____________________________
   Telephone ____________________________

3. Maintenance Staff
   Name ____________________________
   Address ____________________________
   Telephone ____________________________

B. Site Selection

1. ______ Distance Criteria Met
2. ______ Beam Height Above Terrain Criteria Met
3. ______ Path Length Criteria Met
4. ______ Winter Servicing Access Considered
5. ______ Vandalism Considered
6. ______ Isolation From Local Sources Considered
7. ______ Seasonal or Special Area Use Considered
8. ______ Transmitter/Receiver Site Location Documented on Topographic Map/Aerial Photography
9. ______ Sites Photographed Extensively
10. ______ GOES Satellite Transmission Considered

C. Shelter Considerations

1. ______ Type of Shelters to be Used Determined
2. ______ Type of Mounting System to be Used Determined
3. ______ Winter Conditions Considered
4. ______ Shelter Locations Marked Positively
5. ______ Post Mount Locations Marked Positively
6. ______ Frost Level Considered

REV 1  3/87
D. Power Considerations

1. ____ AC Power
2. ____ Solar Power
3. ____ Thermo-electric Power

E. Installation Considerations

1. ____ Site Access (Vehicle Access)
2. ____ Site Preparation
3. ____ Directional Orientation
4. ____ Utility Hookup (If Applicable)
5. ____ Installation Schedule

F. Local Support Documentation (Names & Addresses Documented for)

1. ____ Land Management Agency Facilities
2. ____ Hardware Stores
3. ____ Other Support Facilities

II. SITE SELECTION TRIP - EQUIPMENT CHECKLIST

A. Project Discussion Materials

1. ____ Trip Visit Letter 5. ____ Shelter Pictures and Mailed Plans
2. ____ Contact Names/ 6. ____ Power Requirements Number
3. ____ Visibility Program 7. ____ Servicing Requirements Literature
4. ____ Pictures of Previous Installations

B. Site Selection Materials

1. ____ Topographic Maps 8. ____ Theodolite and Tripod
2. ____ Ruler and Protractor 9. ____ Telescopes and Tripods
3. ____ High Altitude 10. ____ Laser Range Finder Photography
4. ____ Survey Tape, 11. ____ Compass
5. ____ Camera, Lens, Film, 12. ____ Inclinometer Supplies
6. ____ Signal Mirrors
7. ____ Signal Strobe Light

C. Mounting Post Site Selection

1. ____ Shovel 4. ____ Hand Rock Drill
2. ____ Spike 5. ____ Tape Measure
3. ____ Sledge Hammer 6. ____ Post Base Plate Template

REV 1 3/87
DATE: September 17, 1987

TO: All IMPROVE and NPS-IMPROVE Unit sites

FROM: Tom Cahill, Bob Eldred, and Pete Beveridge
Air Quality Group, Crocker Nuclear Laboratory

RE: Start Up of IMPROVE modules.

At the IMPROVE meeting of August 18, 1987, a proposal was made and accepted to start up the IMPROVE network on or about October 7, 1987. This was contingent upon completion of tests and fabrication of minor parts, which now appears to be accomplished.

We will be coming to each site, during which period—three hours, we will:

1. Make certain final modifications of the IMPROVE units (see list),
2. perform final field calibrations,
3. meet for 30 minutes with operators to review operation manuals and procedures,
4. and start up the unit.

We very much appreciate the time and effort you have already put in to get the sites prepared, power in, and arrange for staffing, etc.
List of Improve sampler modifications

1. Move existing vacuum gauge to read upstream of critical orifice.
2. Place orifice meter between critical orifice and manifold in module "D".
3. Place protective coverings over transformer and heating element in controller.
4. Insert denuder into stack of Module "B".
5. Connect high pressure port of magnehelic to lower port of stainless steel tee of stack.

List of Air Quality Group Members who will visit which sites
for Improve Samplers starting up October 1-10

Bob Eldred
MOUNT RAINIER
GLACIER
DENALI
Pete Beveridge and Bob Matsumura
CRATER LAKE #
JARBRIDGE #
BRIDGER #
YELLOWSTONE *

David Everitt
YOSEMITE
PINECLES *
SAN GORONIO

Steve Teague
GRAND CANYON
PETRIFIED *

Tony Tanada
BRYCE CANYON
CANYONLANDS
ARCHES *

Marcelle Surovik
MESA VERDE
WEMINUCHE
ROCKY MOUNTAIN

Paul Wakabayashi
CHIRICAHUA
GUADALUPE MINS *
BIG BEND

Brian Perley
GREAT SMOKY MTNS
SHENANDOAH
ACADIA

Tom Cahill
HAWAII VOLCANOES * #
HALEAKALÁ * #
Pete Beveridge
SUPERSTITION #

* = Not IMPROVE NETWORK site
# = Has not been installed
DATE: August 18, 1987

TO: William C. Malm and Marc Pitchford
NPS, Ft. Collins; EPA, Las Vegas

FROM: Thomas A. Cahill and Robert A. Eldred
Crocker Nuclear Laboratory

Progress Report 3

IMP/ROVE* Network

U.C. Davis Design Team
T.A. Cahill R.A. Eldred
R. Wilkinson C. Goodart (1)
P. Beveridge P. Feeney
O. Raabe, LEHR, UC Davis
S. Teague, LEHR, UC Davis

SUMMARY

1. Nine sites are setup, four more will be setup by 9/10/87, and three more by fall.

2. The testing is well advanced—at WHITEX, at SCMQS and at Davis.

3. The Davis test site will startup 9/8/87 on a three-week schedule. One month is needed to test all channels, including the testing of the denuder.

4. Delays: First, three sites are delayed; second, the mailers are due 9/15/87; third, changes to the denuder due to be completed by 9/20/87.

Recommended startup date is Wednesday, October 7, 1987

*Interagency Monitoring for Protected Visual Environments—program of NPS, EPA, USFS, BLM, Fish & Wildlife.

(1) Certified Engineer
1. SITES

IMPROVE NETWORK site setup status as of 13-Aug-87

<table>
<thead>
<tr>
<th>Today</th>
<th>10-Sep-87</th>
<th>More extended preparation</th>
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<tbody>
<tr>
<td>Acadia</td>
<td>Crater Lake</td>
<td>Yosemite</td>
</tr>
<tr>
<td>Bryce</td>
<td>Great Smoky</td>
<td>Superstition</td>
</tr>
<tr>
<td>Canyonlands</td>
<td>Mesa Verde</td>
<td></td>
</tr>
<tr>
<td>Denali</td>
<td>San Gorgonio</td>
<td></td>
</tr>
<tr>
<td>Grand Canyon</td>
<td>Bridger</td>
<td></td>
</tr>
<tr>
<td>Mt. Rainier</td>
<td>Jarbridge</td>
<td></td>
</tr>
<tr>
<td>Rocky Mtn</td>
<td>Chiricahua</td>
<td></td>
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<tr>
<td>Shenandoah</td>
<td>Big Bend</td>
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<tr>
<td>Weminuche</td>
<td>Chiricahua</td>
<td></td>
</tr>
</tbody>
</table>

NPS NETWORK site setup status as of 13-Aug-87

| Hawaii Vol  | Guadalupe       | Arches                     |
| Pinnacles   |                 | Virgin Islands             |
| Yellowstone |                 | Haleakalai                 |
| Voyageur    |                 | Badlands                   |
                                      | Bandelier                  |
                                      | Lassen                     |
                                      | Great Sand Dunes           |
                                      | Redwood                    |
                                      | Pt Reyes                   |
                                      | Petrified Forest           |
                                      | Isle Royale                |

Some of the problems at specific sites include:

- Crater Lake: Hole in roof
- Yosemite: power cable, EIR
- Glacier: power losses in line
- Isle Royale: generator/control panel

2. MAILERS

The mailer boxes are yet to be send to individual sites. There will be one mailer per week per site which will include 8 filters—well coded.

3. CHANNELS

CHANNEL A: Fine Particle Teflon/ cyclone: Mass/Abs/H/elements
No problems; parallels existing SFU’s

CHANNEL B: Organics quartz/ cyclone: (organic C, Elemental C= Total C)
No problems; tested at WHITEX/SCAQS

CHANNEL C: Particulate Nitrate Denuder-Nyloarh/ cyclone: (Nitrate, Nitrite, Sulfate, Chloride) Effectiveness of denuder to be completed 9/20/87
CHANNEL D: PM10 Mass Teflon-PM10 inlet/ cyclone: Mass
No problems sampling; Retention under transport under
evaluation—Coatings?

Pumps: Have occasionally had start-up problems; testing
will be done 9/87.

OPERATORS MANUAL

Second draft is nearing completion—with field comments.

TRAINING

All field personnel have had at least one training session. Comment: We
deply appreciate the extensive work and assistance recently provided by field
personnel on installation and calibration.

RECOMMEND: Start up on 10/7/87

ANALYSIS

1. (UCD) Mass, Absorption, PIXE—improved sensitivity (x3 to 4)

2. (DRI) Organics—excellent agreement at WHITEM, on Teflon/quartz. No
serious artifact formation in dual filter pack test.

3. (RTI) Sulfates—nulasorb may make SO₃ measurement too high (gas
conversion); S (PIXE)—SO₄ on Teflon excellent.

4. (RTI) Nitrate/Nitrite—Blank problems in WHITEM data appears solves;
good precision—await SCAQS test results.

BUDGET

Estimates of costs were realistic; total costs still somewhat uncertain.
APPENDIX: DENUDER TESTS

Measurements of particulate nitrate in field conditions have proven difficult, and many if not most monitoring programs have had great difficulty avoiding artifact formation and/or loss in their systems.

A major attempt to resolve this problem occurred at the California Air Resources Board (CARB) Nitrogen Intercomparison, Los Angeles, 1985. [See title, groups, and abstract attached.] This study showed that the Difference Denuder Method (DDM) on Nylasorb™ filters was as good as any method tested, and had the advantage of a transportable filter for field program. Further tests by Dr. Walter John (Air & Industrial Hygiene Lab, Berkeley) showed that almost any attempt to transport nitric acid through tubing resulted in serious loss, and even the aluminum (oxide) inlet of a virtual impactor removed a large fraction. He then built an Al₂O₃, anodized denuder, which did very well.

On this basis, we designed a 5 tube denuder for WHITEX, which, while theoretically sound and appearing to work to some degree, caused us some concern as it gave higher particle-vapor ratios than other investigators.

A new cylindrical geometry was designed, calculated to achieve 99.9+% removal, and tests were initiated on June 15 with glass and aluminum, uncoated and coated with Na₂CO₃, of the cylindrical design and the older 5 tube design. Results should start to be received by 9/1/87, and all new units will be completed by 9/20/87. Field retrofit should take no more than 10 minutes.
<table>
<thead>
<tr>
<th>IMPROVE* Particulate Network Site List</th>
<th>DAVIS: CROCKER NUCLEAR LABORATORY</th>
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**IMPROVE NETWORK:** Improve sampler without SO₂

1. ACAD  ACADIA NATIONAL PARK
2. BIBE  BIG BEND NATIONAL PARK
3. BRCA  BRYCE CANYON NATIONAL PARK
4. CNY  CANYONLANDS NATIONAL PARK
5. CHIR  CHIRICAHUA NATIONAL MONUMENT
6. CRLA  CRATER LAKE NATIONAL PARK
7. DENA  DENALI NATIONAL PARK AND PRESERVE
8. GLAC  GLACIER NATIONAL PARK
9. GRCA  GRAND CANYON NATIONAL PARK
10. GRSM  GREAT SMOKY MOUNTAINS NATIONAL PARK
11. MEVE  MESA VERDE NATIONAL PARK
12. MORA  MOUNT RAINIER NATIONAL PARK
13. ROMO  ROCKY MOUNTAIN NATIONAL PARK
14. SHEN  SHENANDOAH NATIONAL PARK
15. YOSE  YOSEMITE NATIONAL PARK
16. SAGO  SAN GORGONIO WILDERNESS
17. WEMI  WEMINUCHE WILDERNESS
18. BRID  BRIDGER WILDERNESS
19. JARO  JARBRIDGE WILDERNESS
20. SUPE  SUPERSTITION WILDERNESS

**NPS NETWORK:** Improve sampler plus SO₂

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<td>HAVO</td>
<td>HAWAII VOLCANOES NATIONAL PARK</td>
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<td>ISRO</td>
<td>ISLE ROYALE NATIONAL PARK island</td>
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<td>FOPE</td>
<td>POINT REYES NATIONAL SEASHORE</td>
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**STACKED FILTER UNITS (SFU’s)**

**New SFU Wilderness site**

JEFF  JEFFERSON NATIONAL FOREST, POTTS MIN

**SFU sites already running—Bill Malm**

BELA  BERING LAND BRIDGE NATIONAL PRESERVE
GAAR  GATES OF THE ARCTIC NATIONAL PARK & PRESERVE
WRST  WRANELL-ST. ELIAS NATIONAL PARK & PRESERVE

**SFU sites funded through NPS Alaska Regional Office—Alan Elias**

KATH  KATHAI NATIONAL PARK PRESERVE
NOAA  NORTHWEST ALASKA AREAS

**SFU site funded through Univ. of Alaska—Glen Shaw**

YUCH  YUKON CHARLEY RIVERS NATIONAL PRESERVE

**SFU site funded by own NPS local funds**

BUFF  BUFFALO NATIONAL RIVER

**SFU site funded by California ARB—Lowell Ashbaugh**

SEQU  SEQUOIA NATIONAL PARK

**QA site: SFU and Improve sampler plus SO₂—Bill Malm**

DAVI  DAVIS

**Existing SFU site to be shut down?**

SANG  SANGURO NATIONAL MONUMENT

* Interagency Monitoring for Protected Visual Environments—NPS, EPA, USFS, F&W
THE NITRIC ACID SHOOTOUT: FIELD COMPARISON OF MEASUREMENT METHODS

S. V. Hering¹, D. R. Lawson², I. Allegrini³, A. Febo³, C. Perrino³ and M. Possanzini³,
J. E. Sickles II⁴, K. G. Anlauf⁵, A. Wiebe⁵, B. R. Appel⁶, W. John⁶, J. Ondo⁶, S. Wall⁶,
R. S. Braman⁷, R. Sutton⁷, G. R. Cass⁸, P. A. Solomon⁸, D. J. Eatough⁹, N. L. Eatough⁹,
E. C. Ellis¹⁰, D. Grosjean¹¹, B. B. Hicks¹², J. D. Womack¹², J. Horrocks¹³, K. T. Knapp¹⁴,
T. G. Ellestad¹⁴, R. J. Paur¹⁴, W. J. Mitchell¹⁴, M. Pleasant¹⁵, E. Peake¹⁶, A. MacLean¹⁶,
W. R. Pierson¹⁷, W. Brachaczek¹⁷, H. I. Schiff¹⁸, G. I. Mackay¹⁸, C.W. Spicer¹⁹,

¹ Chemical Engineering, University of California, Los Angeles, CA 90024
² California Air Resources Board, Sacramento, CA 95812
³ Consiglio Nazionale delle Ricerche, Rome, ITALY
⁴ Research Triangle Institute, Research Triangle Park, NC 27709
⁵ Atmospheric Environment Service, Toronto, Ontario, CANADA M3H 5T4
⁶ California Department of Health Services, Berkeley, CA 94704
⁷ Department of Chemistry, University of South Florida, Tampa, FL 33620
⁸ Environmental Engineering Science, California Institute of Technology, Pasadena, CA 91125
⁹ Thermochemical Institute, Brigham Young University, Provo, UT 84602
¹⁰ Research and Development, Southern California Edison, Rosemead, CA 91770
¹¹ Daniel Grosjean & Associates, Ventura, CA 93003
¹² National Oceanic and Atmospheric Administration, Oak Ridge, TN 37831
¹³ California Air Resources Board, El Monte, CA 91731
¹⁴ Environmental Protection Agency, Research Triangle Park, NC 27711
¹⁵ Northrup Services, Research Triangle Park, NC 27711
¹⁶ Kananaskis Centre for Environmental Research, University of Calgary,
   Calgary, Alberta, CANADA T2N 1N4
¹⁷ Ford Motor Company, Dearborn, MI 48121
¹⁸ Unisearch Associates, Toronto, Ontario, CANADA L4K 1B5
¹⁹ Battelle Columbus Laboratories, Columbus, OH 43201
²⁰ Department of Chemistry, University of Denver, Denver, CO 80208
²¹ Statewide Air Pollution Research Center, University of California, Riverside, CA 92521
Abstract

Eighteen instruments for measuring atmospheric concentrations of nitric acid were compared in an eight day field study at Pomona College, situated in the eastern portion of the Los Angeles Basin, in September 1985. The study design included collocated and separated duplicate samplers, and the analysis by each laboratory of a set of quality assurance filters, so that the experimental variability could be distinguished from differences due to measurement methods.

For all sampling periods, the values for nitric acid concentrations reported by the different instruments vary by as much as a factor of four. The differences among measurement techniques increase with nitric acid loading, corresponding to a coefficient of variation of 40%. In contrast, samplers of the same design operated by the same group show variability of 11% to 27%.

Overall, the highest reported concentrations are observed with the filter packs and lower concentrations are observed by the annular denuders and tunable diode laser absorption spectrometers. When the nitric acid concentrations are high enough to be detected by the FTIR, the FTIR values are close to those obtained by the denuder difference method and to the mean value from the other sampler groups.

In the absence of a reference standard for the entire study, measurement methods are compared to the average of four denuder difference method samplers (DDM). Filter pack samplers are higher than the DDM for both daytime and nighttime sampling. Two different filter packs using Teflon prefilters are higher than the DDM by factors of 1.25 and 1.4. The results from the three annular denuders do not agree; the ratios of means to the DDM value are 1.0, 0.8 and 0.6. For the transition flow reactor method and for two dichotomous samplers operated as denuder difference samplers, the ratio of means to the DDM are 1.09 and 0.93 respectively. The tunable diode laser absorption spectrometers gave lower daytime and higher nighttime readings compared to the DDM, especially during the last three days of the study. Averaged over the entire measurement period, the daytime ratio of TDLAS to DDM is 0.8 and the nighttime ratio is 1.7.