Letter to State and Local Air Quality Agencies
c/o STAPPA/ALAPCO

This is a long overdue letter to follow up on my March 11, 1998 communications to you concerning selection of sites for the expansion of the IMPROVE network. In that letter I provided a list of 30 candidate sites nominated by the IMPROVE steering committee out of which we would select 20 for expansion during calendar year 1998 and asked for assistance in determining where new sites should be placed. Remember there are 156 Class I Areas and that the overall plan envisions a network of 108 IMPROVE monitoring sites that would be able to collect data required by the anticipated regional haze rule. The goal of the expansion is to provide *adequate* representative regional haze monitoring for each Class I Area. I received many replies to this request with a variety of suggestions and comments.

One of the comments received from several states had to do with equitable selection of sites on a national/regional basis. I share this concern and in fact have made it the basis for making substantial changes to the plan for site selection that was announced in the March letter. Basically the concern is that by selecting sites in a piecemeal fashion we could end up with some Class I Areas with relatively poor data representation by having the nearest monitoring site rather far from the class I area. Meanwhile there might be other regions where there are several monitoring sites very closely spaced.

In June I communicated my concern to the IMPROVE steering committee with a suggestion that we adopt a simple screening method to determine a national strategy of priorities for selecting new monitoring sites among the Class I Areas. The proposal made at that time was that (1) Class I Areas should be represented by monitoring at sites at least within 100km and (2) the monitoring site should be at an elevation between the maximum and minimum elevations of the Class I Areas it monitors. A third criterion was suggested that major emission sources should be at least twice as far from the monitoring site as the Class I Area(s) its data represents.

The first two criteria were used to evaluate the ability of the existing IMPROVE and IMPROVE protocol sites to represent Class I Areas and to estimate how many additional monitoring sites would be required to represent those not covered by existing sites. The process to do this involved determining clusters or groups of Class I Areas that could meet the first criterion based on their locations (i.e. no Class I Area in a cluster is further than 100km from another in the cluster).

The attached table and map show the clusters of Class I Areas that result from the process that was applied. The map shows 100km circles around the exiting IMPROVE or Protocol monitoring sites (designated by I or P on the map) or the centroid of the Class I Areas in the clusters. Cluster identification numbers cross-reference the table

to the map.[1] The 156 visibility-protected Class I Areas are reduced to 92 clusters of which 27 are already covered by the 30 IMPROVE monitoring sites. However, using the elevation criterion, 8 of the clusters require a second monitoring site at a different elevation, leaving 73 clusters to be covered by monitoring at additional sites. There is one cluster (#28) where the amount of overlap in elevations is very small, and another (#3) where the IMPROVE site is only slightly higher in elevation than allowed. Additional sites may also be required to avoid violating the third criterion of being too close to major source areas compared to the distance to the Class I Areas to be represented by the monitoring site. For instance cluster #77 includes Class I Areas that surround the Los Angeles Basin and probably can't be covered by a single site at San Gorgonio. Some clusters can not be routinely monitored for practical and economic reasons; the most notable example is Bering Sea (# 80). In other words we expect the need for some fine-tuning of the selection process using the knowledge of those who know these areas the best and are asking for your help to identify where this needs to be done.

The table also shows 28 IMPROVE Protocol sites near Class I Areas that are operated by the federal land managers (FLM). Of these, 24 have elevations that make them reasonable candidates to be used to cover some of the 75 sites required. We are aware that there are additional monitoring sites that are not listed here, but they may be appropriate candidates for clusters in need of monitoring and are asking that you help us identify these.

Not all protocol sites have the complete particle monitoring capabilities of an IMPROVE site (e.g. at some only one of the four filter samples are collected), so in many cases a more complete sampler and additional analyses are required for comparability to the IMPROVE sites. The steering committee proposes to evaluate each of the FLM protocol sites, and any other sites brought to our attention, that may be useful in fulfilling the needs of the expanded network. The advantages of using existing sites includes the historic data record as well as the savings associated with already having a site with electric power, security, and an operator. For some existing sites, the FLM or other operator may be willing to guarantee continued operation of the site and data sharing for the foreseeable future with no cost or cost sharing with IMPROVE. In other cases IMPROVE may need to cover all costs to ensure continued data collection at a site. Possible savings by having current protocol site sponsors contributing to the cost of the expanded IMPROVE program could be used to fund additional sites. However, at this stage in the planning process the object is to design a network that provides adequate spatial coverage with the resources presently committed for this purpose.

I am again asking for your comments and suggestions. Specifically I would appreciate knowing your thoughts on the following issues:

1. Do you agree that some method to identify clusters of Class I Areas that can be covered by a single monitoring site with respect to regional haze impacts should be part of the planning process?

---

[1] Some pairs of adjoining clusters have the same number but are distinguished by the letter "a". These clusters very nearly meet the 100km criterion to be covered by one site.

2. As a coarse site selection screening method, is the 100km distance and elevation criteria as used here to identify clusters and additional required monitoring sites adequate? If not please suggest another method that we could consider that can be implemented over the next few months and would allow data collection that could be considered representative of the regional haze for all 156 visibility protected areas.
3. For regions that you are familiar with, can you suggest alternative clusters of Class I Areas that would make more sense than those in the table, yet would not substantially increase the total number of monitoring sites required? You may want to include additional criteria (e.g. transport meteorology) that may be important for some Class I Areas. For example you might merely rearrange some of the Class I Areas in clusters to better reflect knowledge of the major air basins or regionally influential sources. Also, in regions with relatively flat terrain a monitoring site further than100km may provide adequately representative monitoring data. Finally do you know of other existing sites that should be considered for clusters needing monitoring?

Progress on the expansion has been slowed this spring and summer while funds and contracts were put into place. However, these issues are close to being resolved and while it is unlikely we will get all 20 sites installed by the end of 1998, it is still our goal. I would appreciate receiving comments by the end of September, since in order to deploy the first 20 sites this calendar year we need to be directing our aerosol monitoring contractor to begin site selection visits by mid-October.

As indicated in my previous letter to you, we intend to communicate with the responsible state agencies prior to site visits in order to ensure their participation in the site selection process. I encourage state and local agencies to contact local FLMs and discuss this proposal's implications for your area. A number of letters I have received stress the importance of state and local approval of monitoring sites. From a regulatory standpoint, states will be able to indicate in their regional haze SIPs their acceptance or not of monitoring sites for the purpose of the regional haze program. However, the SIP process will not occur for several years and the expansion of IMPROVE is occurring during the next 18 months. The best way to ensure your needs are met is through working collaboratively with IMPROVE and local federal land managers. I am available to work through issues and others on the steering committee have also indicated their willingness to help.

I look forward to seeing your comments and suggestions for the proposed network. If you have questions or want to discuss issues, feel free to email or call me at marcp@dri.edu or 702-895-0432.

Sincerely,

Marc Pitchford, Ph.D
IMPROVE Steering Committee Chair

Table 1. Clusters of all Class I Areas with visibility protection based upon the 100km distance criterion with maximum and minimum Class I Area elevations as well as the elevations of IMPROVE and of federal land manager Protocol sites. For clusters without current IMPROVE monitoring or where that monitoring doesn't meet the elevation criterion, the maximum and minimum elevations for future required sites are shown. Sites within 100' or 10% of the required elevation range were considered to have met the elevation criterion. An asterisk (*) indicates protocol sites with elevations that are within the required site maximum and minimum elevation range. Some pairs of adjoining clusters have the same number but are distinguished by the letter "a". These clusters very nearly meet the 100km criterion to be covered by one site.

Cluster #	Cluster ID	Class I Areas in Each Cluster	Min Elev Class I (ft)	Max Elev Class I (ft)	Elev. of IMPROVE (ft)	Required Minumum (ft)	Required Maximum (ft)	Elev. of Protocol Sites (ft)
1	Acadia	Acadia NP	0	1,530	420			
2	Moosehorn	Moosehorn W	0	480		0	480	130*
		Roosevelt Campobello IP						
3	Lye Brook	Lye Brook W	800	2,941	3,250	800	2,900	
4	Great Gulf	Great Gulf	1,680	5,807		1,680	5,413	1440*
		Presidential Range-Dry River W	880	5,413				
5	Brigantine	Brigantine W	0	15	50			
6	Shenandoah	Shenandoah NP	530	4,050	3,600			
6a	James River	James River Face W	650	3,073		650	3,073	720*
7	Dolly Sods	Dolly Sods W	2,620	4,122	3,800			
		Otter Creek W	1,830	3,912				

8	Mammoth Cave	Mammoth Cave NP	414	919	774			
9	Great Smoky Mtns	Great Smoky Mtns NP	850	6,643	2,700			
		Shining Rock W	3,180	6,030	5,290			
		Joyce Kilmer-Slickrock W	1,100	5,341				
9a	Cohutta	Cohutta W	980	4,149		980	4,149	
10	Linville Gorge	Linville Gorge W	1,650	4,120		1,650	4,120	
11	Swanquarter	Swanquarter W	0	2		0	2	
12	Cape Romain	Cape Romain W	0	25	5			
13	Okefenokee	Okefenokee W	105	125	50			
		Wolf Island W	0	6				
14	St Marks	St Marks W	0	42		0	42	
15	Chassahowitzka	Chassahowitzka W	0	5		0	5	10*
16	Everglades	Everglades NP	0	6		0	6	0*
17	Breton Is	Breton Is W	0	2		0	2	
18	Sipsey	Sipsey W	540	1,070	600			
19	Seney	Seney W	703	801		703	801	
20	Boundary Waters	Boundary Waters Canoe W	1,260	2,301	1,700			
20a	Voyageurs	Voyageurs NP	1,100	1,400		1,100	1,400	

21	Isle Royale NP	Isle Royale NP	601	1,394		601	1,394	
22	Mingo	Mingo W	332	590		332	590	
23	Upper Buffalo	Upper Buffalo W	1,240	2,340	2,300			
		Hercules-Glades W	760	1,360		760	1,360	
24	Canney Creek	Canney Creek W	1,065	2,330		1,065	2,330	
25	Wichita Mtn	Wichita Mtn W	1,465	2,260		1,465	2,260	
26	Big Bend	Big Bend NP	1,720	7,825	3,500			
27	Guadalupe Mtns	Guadalupe Mtns NP	3,630	8,749		3,880	8,749	5400*
		Carlsbad Caverns NP	3,880	8,960				
28	Bandelier	Bandelier NM	6,066	8,182		8,000	8,182	6,500
		San Pedro Parks W	9,400	10,523				
		Pecos W	8,000	13,103				
29	Wheeler Peak W	Wheeler Peak W	7,840	13,161		7,840	13,161	
30	Salt Creek	Salt Creek W	3,525	3,650		3,525	3,650	
31	White Mtn	White Mtn W	6,000	11,580		6,000	11,580	
		Bosque del Apache W	4,597	5,930		4,597	5,930	
32	Chirchahua	Chirchahua NM	5,100	7,800	5,400			
		Chircahua W	4,680	9,759				

33	Saguaro NP - East	Saguaro NP – East	2,720	8,666		2,720	7,663	
		Galiuro W	3,995	7,663				
34	Petrified Forest	Petrified Forest NP	5,310	6,234		5,310	6,234	5500*
34a	Gila	Gila W	5,700	10,770		5,700	10,770	5840*
35	Mount Baldy W	Mount Baldy W	9,219	11,407		9,219	11,407	
36	Tonto	Superstition W	1,610	6,266	2,600			
		Sierra Ancha W	5,200	8,000		5,200	8,000	
		Mazatzal W	1,600	7,904				
37	Pine Mtn W	Pine Mtn W	4,600	6,814		4,600	6,814	
38	Sycamore Canyon	Sycamore Canyon W	3,580	7,000		3,580	7,000	
39	Grand Canyon	Grand Canyon NP	1,200	9,125	7,100			
40	Bryce Canyon	Bryce Canyon NP	6,600	9,115	8,100			
		Zion NP	3,700	8,726				
41	Canyonlands	Canyonlands NP	3,697	7,211	5,950			
		Arches NP	3,981	5,653				
41a	Capitol Reef	Capitol Reef NP	3,800	8,200		3,800	8,200	
42	Great Sand Dunes	Great Sand Dunes NP	8,200	8,900		8,200	8,900	8200*

43	Meas Verde	Meas Verde NP	6,300	8,400	7,210			
		Weminuche W	8,000	14,083	9,050			
		La Garita W	9,000	14,014				
		West Elk W	7,500	13,035				
		Black Canyon of the Gunnison NM	5,440	9,040				
44	Flat Tops	Maroon Bells W	7,500	14,265		7,850	12,354	11212*
		Flat Tops W	7,600	12,354				
		Eagles Nest W	7,850	13,534				
45	Rocky Mtn	Rocky Mtn NP	7,620	14,255	8,950			
		Rawah W	8,400	12,951				
		Mount Zirkel W	7,400	12,180				10,557
46	Badlands	Badlands NP	2,440	3,140		2,440	3,140	2493*
		Wind Cave NP	3,580	5,013		3,580	5,013	
47	Theodore Roosevelt	Theodore Roosevelt NP		2,855			2,855	
48	Lostwood	Lostwood W	231	2,442		231	2,442	
49	Medicine Lake	Medicine Lake W	1,935	2,045		1,935	2,045	
50	UL Bend	UL Bend W	2,250	2,675		2,250	2,675	
51	Bridger	Bridger W	7,500	13,804	8,000			
		Fitzpatrick W	6,000	13,804				

52	Yellowstone	Yellowstone NP	5,282	11,358		7,200	9,600	7744*
		Grand Teton NP	6,350	13,770				
		Red Rock Lakes W	6,600	9,600				
		North Absoraka W	6,250	12,188				
		Washakie W	6,460	13,100				
		Teton W	7,200	12,156				
53	Jarbidge	Jarbidge W	6,500	10,800	6,200			
54	Craters of the Moon	Craters of the Moon NM	5,340	7,729		5,340	7,729	5900*
55	Sawtooth	Sawtooth W	5,150	10,750		5,150	10,750	6490*
56	Selway	Selway-Bitterroot W (Sula Peak)	1,600	10,131		5,100	10,131	6191*
		Anaconda-Pintler W	5,100	10,793				
57	Glacier	Glacier NP	3,219	10,448	3,200			
58	Marshall	Bob Marshall W	4,000	9,356		5,000	7,980	
		Mission Mtns W	4,500	9,360				
58a	Scapegoat	Scapegoat W	5,000	9,411		3,750	7,980	
		Gates of the Mtns W	3,750	7,980				
59	Cabinet Mtns	Cabinet Mtns W	3,000	8,738		3,000	8,738	
60	Eagle Cap	Eagle Cap W	4,000	9,839		4,000	9,300	
		Hells Canyon W	1,200	9,300				
61	Strawberry Mtn	Strawberry Mtn W	4,196	8,900		4,196	8,900	

62	Mt Rainier	Mt Rainier NP	1,380	14,411	1,380			
		Goat Rocks W	2,240	8,184		2,391	7,972	
		Mt Adams W	2,391	7,972				
		Alpine Lakes W	1,700	9,297				3600*
63	North Cascades	North Cascades NP	330	9,206		2,600	9,066	
		Pasayten W	2,600	9,066				
		Glacier Peak W	1,154	10,587				
64	Olympic	Olympic NP	0	7,969		0	7,969	
65	Mt Washington	Three Sisters W	1,781	10,298		3,074	7,231	2,850
		Mt Jefferson W	2,972	10,358				
		Mt Washington W	3,074	7,231				
65a	Mt Hood	Mt Hood W	1,800	9,200		1,800	9,200	
66	Crater Lake	Crater Lake NP	1,932	8,926	6,500			
		Diamond Peak W	4,383	8,563				
		Mtn Lakes W	4,820	8,196				
67	Lava Beds	Gearhart Mtn	5,984	8,300		5,984	8,300	
		Lava Beds NM	4,000	5,400		4,000	5,400	
67a	South Warner	South Warner W	4,587	9,437		4,587	9,437	
68	Redwood	Redwood NP	0	3,117		741	3,117	760*
		Kalmiopsis W	217	5,092				
		Marble Mtn W	741	7,895				

69	Lassen Volcano	Lassen Volcano NP	na	10,457		6,035	7,678	5759*
		Thousand lakes W	5,353	8,090				
		Caribou W	6,035	7,678				
70	Yolla Bolly	Yolla Bolly Middle Eel W	2,284	7,713		2,284	7,713	
71	Point Reyes	Point Reyes NP	0	1,409		0	1,409	125*
72	Pinnacles	Pinnacles NP	800	3,304		800	3,304	1040*
		Ventana W	540	5,627				
73	San Rafael	San Rafael W	1,109	6,311		1,109	6,311	
74	Desolation	Desolation W	5,938	9,415		5,938	9,415	
75	Yosemite	Yosemite NP	2,000	13,000	5,300			
		Mokelumne W	3,754	9,720				
		Emigrant W	4,593	10,964				
		Hoover W	7,640	12,446		7,640	9,720	
		Ansel Adams W	3,200	12,350				
		Kaiser W	6,660	9,730				
		John Muir W	4,873	13,880				
76	Sequoia	Sequoia NP	1,500	14,494		2,670	9,224	1,800
		Kings canyon NP	1,500	14,494				
		Dome Land W	2,670	9,224				2942*
77	San Gorgonio	San Gorgonio W	3,116	10,911	5,618			
		San Gabrial W	1,593	7,675				
		Cucamonga W	4,285	8,583				
		San Jacinto W	1,348	8,922				
		Agua Tibia W	1,615	4,763		1,615	4,763	
		Joshua tree NM	1,200	5,814				

78	Denali	Denali NP&P	200	20,320	2,100			
79	Tuxedni	Tuxedni W	0	2,674		0	2,674	
80	Bering Sea	Bering Sea W	0	1,475		0	1,475	
81	Simeonof	Simeonof W	0	1,430		0	1,430	
82	Virgin Islands	Virgin Islands NP	0	1,277		0	1,277	150*
83	Hawaii Volcanoes	Hawaii Volcanoes NP	0	13,677		0	13,677	4100*
84	Haleakala	Haleakala NP	0	10,023		0	10,023	3800*

92 clusters | 156 Class I Areas | 30 current IMPROVE | 73 required new sites | 28 protocol sites 24 with *

 92 clusters
-27 clusters are covered by the 30 current IMPROVE sites
 65 clusters need monitoring
 +8 clusters require 2 sites for elevation reason
 73 is the minimum number of new sites required by this screening method
+30 current IMPROVE sites
103 is the minimum total number of IMPROVE sites required by this method (doesn't account for locations that are impractical)