

ILLINOIS POLLUTION CONTROL BOARD
March 16, 1978

IN THE MATTER OF:)
)
THE PROPOSED AMENDMENTS TO) R76-18
RULE 203.1 OF THE WATER)
POLLUTION REGULATIONS)

PROPOSED OPINION AND ORDER OF THE BOARD (by Dr. Satchell):

This matter concerns a proposed amendment to Rule 203.1 of the Chapter 3: Water Pollution Regulations. The proponent Illinois Power Company (IPC) requests that an exception be made to the boron water quality standard for a certain portion of an unnamed tributary to Wood River Creek and Wood River Creek itself below IPC's generating plant known as Wood River Station. "Wood River" and "Wood River Creek" are used interchangeably throughout these proceedings to designate the stream into which the unnamed tributary flows and which empties into the Mississippi River. The language proposed is as follows:

- (b) The boron limitation in Rule 203(f) shall be inapplicable in the unnamed tributary of Wood River Creek which enters Wood River Creek 4700 feet above the confluence of Wood River Creek with the Mississippi River from a point 450 feet above the confluence of the unnamed tributary and Wood River Creek to said confluence, and in Wood River Creek from said confluence to the confluence of Wood River Creek and the Mississippi River, and in lieu of the limitation in Rule 203(f), the boron limitation shall be 25 mg/l in the aforesaid waterways.

This proposal was filed with the Board on September 13, 1976 and published in Environmental Register #135 on October 21, 1976. As this matter is site specific only two hearings were held. The first hearing was on January 25, 1977 in Edwardsville, Illinois. The second hearing which was a joint merit and economic impact hearing was held in Alton, Illinois on August 29, 1977.

This particular problem has been before the Board on several occasions. In PCB 74-9, 12 PCB 81 (1974) and PCB 74-423, 15 PCB 261 (1975) IPC was granted research variances to deal with their boron problem. This research proved unsuccessful and IPC received an additional variance PCB 75-221, 19 PCB 489 (1976), until March 15, 1976. Currently IPC has a variance, PCB 76-74, 22 PCB 53 (1976), pending the resolution of this regulatory proceeding.

Prior to discussing the merits of this regulatory change the Board must rule on two motions still pending in this proceeding. The first motion filed by Illinois Power is to make several corrections to the transcript of the August 29, 1977 hearing. No objections were filed, the motion will be allowed and thereby made a part of the record. The second motion was by the Illinois Environmental Protection Agency (Agency). This motion requests the incorporation of pages 32-414 of PCB 73-509 and 73-510 (consolidated) into the record of this proceeding. These pages include the testimony of Dr. Donald McDonald, William Tucker and Robert Hite concerning the biological condition of Wood River Creek, including the portion of said river downstream from IPC's ash pond discharge. IPC had no objections provided the Agency admit the following facts:

1. That Dr. McDonald's references to the "Ash Pond Discharge" or similar terms (see, for example, pages 99 and 160 of the transcript) in fact refer to the point of confluence of the unnamed tributary referred to in the present proceeding and Wood River Creek and do not refer to the out-fall of Petitioner's ash pond into said unnamed tributary.
2. That said unnamed tributary, in addition to receiving the discharge from Petitioner's ash pond also receives other industrial, commercial or municipal discharges as well as surface run-off.
3. That the areas studied by Messrs. Tucker and Hite and referred to in their testimony are all above or upstream of the point of confluence of the unnamed tributary referred to in the present proceeding and Wood River Creek.

The Agency admitted all the requested facts. The Board will allow the incorporation of pages 32-414 of the earlier proceeding, PCB 73-509, 73-510, into this record.

The facility in question is a fossil-fueled electric generating plant known as the Wood River Station. The two largest units representing 62% of the maximum plant capacity burn coal; the remaining three units burn oil. As part of the operation of the plant, IPC operates an ash lagoon system to treat the fly ash and the bottom ash sluice waters. Water is withdrawn from the Mississippi to sluice the ash to the lagoon for settling suspended solids. After the settling of the solids, the excess water is discharged from the lagoon to the unnamed tributary to Wood River and through Wood River back to the Mississippi.

During the sluicing and settling process in the ash lagoon, soluble boron is dissolved from the ash and discharged, generally in excess of the present standard for boron in Rule 203(f) of

Chapter 3. IPC intends to construct a new ash lagoon because the retention time in the existing lagoon has been reduced by the accumulation of ash so that there will not be sufficient retention time to adequately treat the suspended solids and pH.

Under the Board's current regulations if the current ash lagoon discharge went directly into the Mississippi River the boron standard would be met because of the much larger dilution factor. As it now exists the IPC discharge frequently exceeds the applicable standard for boron for the unnamed tributary and for the segment of Wood River Creek (Pet. at 2, R. 10). The new lagoon is being designed to discharge to the unnamed tributary of Wood River Creek just as the existing lagoon does and it is anticipated that the effluent will continue to exceed the boron standard.

IPC originally explored a number of different alternatives to the boron problem. Because of costs (ranging from \$461,971 to \$2,440,221) and apparent lack of environmental degradation of Wood River, IPC chose to pursue the alternative route that would require this regulatory change (Ex. 1, R. 12, 13). Illinois Power believed that there was inadequate environmental justification for imposing the additional costs of the other alternatives on its customers (R. 13). Illinois Power retained James A. Cox, C. David Schmulbach, Donald R. Tindall and Walter E. Schmid, all PhD's at Southern Illinois University at Carbondale (SIU-C), to investigate this matter (R. 13). The latter three gentlemen all testified at the hearings.

Drs. Schmulbach and Cox conducted research studies for IPC to find an economically and technically feasible method to reduce or remove boron concentrations in the coal ash pond effluent. Their final report (Ex. 2) covered the period March 15, 1974 to June 30, 1975. Dr. Schmulbach testified that: (1) Unfired coal contained 170 ppm boron, (2) Bottom ash contained 960 ppm B, and (3) Fly ash contained 1900 ppm B. In the aforementioned report (Ex. 2), samples of southern Illinois coal used at this plant upon analysis showed boron contents from 118 to 170 ppm B, which was stated to be typical of Eastern Interior Province (96 ppm B ave.) and Northern Great Plains Province (116 ppm B ave.). Appalachian coal was stated to contain 25 ppm B. Exhibit 14 (The Economic Impact Study, IIEQ Doc. No. 77/19) stated that IPC burned Illinois #6 coal until June 1975 from the Streamline Mine. This coal contained 168-170 ppm B and the ash contained about 1900 ppm B. Various coals were burned from July 1975 through September 1976 at which time low sulfur coal supplied by Energy Fuels Corporation of Colorado became the only coal source. This coal, reported to be from the Fishcreek and Wadge Seams, contained about 136 ppm B and produced ash with from 440 to 1400 ppm B depending on the ashing techniques used (Ex. 14 at 7, 8). As mentioned in Exhibit No. 2, one method of boron concentration

control would be to burn coal with a low boron content (Ex. 2 at 10). It is noted that IPC in their selection of a low sulfur coal also acquired a coal lower in boron content.

The values given from the above study for boron content in the coal and in the ash indicate that boron in coal is not in volatile forms (R. 40). Much of the boron in fly ash (about 50%) is readily water soluble; while bottom ash contains a much lower concentration of leachable boron (R. 40, 41). Methods tested to reduce boron concentrations included: (1) High temperature firing of fly ash, (2) Boron adsorption on limestone and clays, (3) Dialysis through ion-exchange membranes, and (4) Adsorption on a boron specific, ion-selective, bead-type resin (R. 40-43). None of these methods were deemed to present a treatment both economically and technologically feasible. Analysis of the water before contact with the ash showed a boron content of 0.35 ppm. This was increased to 3.30 ppm at the hopper discharge and to 5.00 ppm at the Sluice Pond overflow to Wood River. Studies indicated that boron was solubilized within 5 minutes over a pH range of 4-10 (Ex. 2 at 4). Utilizing the data from the study, the researchers stated they calculated the theoretical maximum concentration of boron that could be contained in the effluent. Using worst case assumptions, they concluded the maximum concentration could be 23.7 ppm B (R. 44).

Based on a limited literature review on the toxic effects of boron and data available on the stretch of Wood River affected, Dr. Schmulbach concluded that the boron discharged would present no threat to microinvertebrate and fish populations (R. 45). He recommended a professional botanist conduct a detailed survey of aquatic and terrestrial flora in the Wood River Creek Area to determine if boron damage had occurred (R. 46). Drs. Donald R. Tindall and Walter E. Schmid, professors in the Department of Botany, SIU-C, were retained to conduct the survey. Dr. Tindall specializes in phycology and aquatic vascular plants; Dr. Schmid specializes in plant physiology and particularly in the area of micronutrient element uptake and translocation in higher plants (R. 57).

While the survey was conducted on a single day (July 14, 1976), (R. 58) boron has been discharged into the system for about 25 years (R. 94). Samples of periphyton and phytoplankton from the water were taken. Terrestrial and aquatic vegetation was observed for species diversity and abundance and for evidence of boron toxicity. At nine separate locations selected to be representative of possible affected and non-affected sites, detailed species identification of both terrestrial and aquatic plants were made (Exhibits 3, 4, 5). The results of the study can be summarized very briefly by the following quote: "We can conclude that the boron concentration present in IPC's discharge has not had any discernible adverse effect

on the observed terrestrial and aquatic community, which is typical in constituents, maturity, quantity and in all other respects to those found in this region. In our opinion the continuation of this discharge will not produce any adverse effects on the ecosystem of the unnamed tributary and Wood River Creek" (R. 63, 64).

Water samples taken the next two days (July 15 and 16) upon analysis showed the following boron contents (highest value only): (1) ash pond, 4.4 ppm B, (2) unnamed tributary, 3.3 ppm B, (3) at confluence (in the mixing zone) in Wood River, 2.8 ppm B, (4) upstream from confluence mixing zone in Wood River, 0.7 ppm B, and (5) downstream from mixing zone, 2.1 ppm B, (Ex. 6).

Mr. Cecil A. Longwisch, representing the Madison County Environmental Committee, spoke against granting the exception without a full year study on the effects of boron on the stream biota. His major concern was the food chain culminating with fish. His concern included a fish kill for unknown reasons that apparently occurred in the spring of 1976 (R. 89).

The Agency submitted supplemental data (Ex. 7) concerning boron in the environment. This statement was included; "Several studies have shown that for fresh water fish the toxic level of boron is 2000 ± 950 mg/l as boron." The Agency's statement included quotes from specific studies showing boron to be toxic, teratogenic or mutagenic, when present in high concentrations particularly during the very early developmental stages of some species. In Exhibit 12 submitted by the Agency one document reviewed indicated some posthatch injury, one percent mortality (LC_1), to rainbow trout, channel catfish, and goldfish at concentrations less than 1 ppm B. However, the concentrations necessary to achieve a mortality of 50 per cent (LC_{50}) ranged from 22 to 155 ppm B in this study for these same species. Such large differences in lethal concentrations (LC) from a one percent to a 50 percent concentration cast some doubt on the accuracy of the difficult-to-determine LC_1 concentrations. IPC's aquatic biologist, James A. Smithson, also testified concerning the fish kill and the very high boron levels reported in the literature needed for lethal concentrations to fish. For example, he cited Turnbull who reported a 24-hour TL_m for bluegill, to be 2,400 ppm B, when supplied as boron trifluoride (R. 146). The term "median tolerance limit" (TL_m) is essentially equal to LC_{50} and when coupled with the time of exposure (often 96 hours) is the usual method of expression in fish toxicity studies.

With respect to the aforementioned fish kill the previous spring on Wood River Mr. Smithson reported: (1) That he personally noted dead gizzard shad more than one-half mile upstream from IPC's discharge and (2) That Mr. Rudy Stinauer, Region IV Fisheries Manager, Department of Conservation, had investigated the fish kill and had sent him a letter (Ex. 10) stating that he

had observed dead gizzard at a point more than one mile upstream of IPC's discharge point (R. 146). Mr. Smithson testified that he conducted a biological survey in Wood River Creek upstream and downstream from the confluence of the unnamed tributary, the unnamed tributary itself, and the Illinois Power discharge ditch. Fish were sampled with a seine, and the benthic community was sampled with a Ponar dredge. No fish were found in Wood River Creek. IPC's effluent ditch yielded 70 green sunfish and the greatest diversity and abundance of benthic organisms. The population structure of the sunfish suggests they are reproducing in the ditch and have done so for more than one year. "The greater diversity and number in the Illinois Power ditch, and the lack of such in the Wood River Creek, suggest the Illinois Power effluent not only does no harm to the aquatic community but in fact supports a better community of aquatic organisms than the Wood River Creek" (R. 148, 149).

As previously noted a portion of the record from PCB 73-509 and 73-510 was referenced into these proceedings. In discussing the lower portion of Wood River, Dr. D. B. McDonald, a limnologist and witness for Olin stated they found it had a very low productivity. "The habitat variety was very limited, very very limited in this area. In other words, I would say this is a very poor habitat for the propagation of fish. It is not a desirable spawning or nursery area because of the limited habitat types. It supports neither a variety, nor a real abundance of organisms in general." (PCB 73-509 and 73-510, at 100). "...The low head dam and the channelization together, and, of course, to a lesser extent, the levee all contribute to the fact that this stream is very different than the typical unmodified midwestern stream" (Id. at 101). "I would say that from what I worked on other midwestern streams, that the fish community of the upper sections of Wood River is very typical of a small midwestern prairie stream...Now, to go to the other end of the fish community in the stream, the section influenced by the dam is composed of carp, shad, and a few gar. This is the area where the ponding occurs, where there is very little current, where you have this very silty bottom" (Id. at 114, 115).

Dr. McDonald stated that many river fish utilize smaller tributaries to spawn and to feed in. In this case such fish were not found above the dam suggesting the dam restricted fish movement from the Mississippi up Wood River (Id. at 116). He further stated that, "I see no evidence to believe that Wood River does or is capable of supporting fishery of sport or commercial significance" (Id. at 120).

Water samples were taken for chemical analyses. Although the water contained several regulated elements in concentrations above those specified in the water quality regulations, no consistent relationship was shown between chemical content and biota assay. Dr. McDonald stated, "It is my opinion that the

major factor influencing the composition of the biota, the number of species present, the major limiting factors if you will, are the morphometric factors, channelization, the low head dam" (Id. at 273).

Agency aquatic biologists, William J. Tucker and Robert L. Hite, conducted surveys on Wood River. Mr. Hite stated, "So in summary, the limitations to the aquatic biota are other than habitat limitations, and in my opinion are water quality limitations" (Id. at 356). The Agency did not take water samples for chemical analysis to complement the biological surveys. Nor were samplings or surveys made in the lower reaches of Wood River (Id. at 388, 392).

Since the exhibits to accompany the above transcripts were not incorporated into this proceeding, it was difficult to follow exactly what portions fell into the Agency's classification of polluted, balanced, etc. However, since all of the Agency sampled areas apparently were upstream of the area being considered, the Board is disposed to agree with Dr. McDonald in that Wood River would present a very poor habitat for aquatic organisms from the ash pond effluent to the low head dam.

From the studies and surveys relating to this specific segment of Wood River and the unnamed tributary, the Board concludes that environmental effects of boron released by IPC in the past have been minimal. The suite of conditions presented at this location are particularly unique: (1) The stream segment is placed in a highly developed industrial area -- thus there is little or no possibility of water use for domestic or irrigational purposes, (2) The morphology of the stream with the "low head" dam, silty or sandy shifting bottoms, and channelization--destroying protective pools--practically preclude the presence of the boron-sensitive early developmental stages of fish reproduction and (3) The stream empties into the Mississippi River, causing high dilution thereby preventing any downstream concerns.

IPC's analyses for boron prior to about 1976 are, at best, subject to question. The method used for analysis is suitable for concentrations up to 1 mg B/l. Since IPC's boron concentration at their ash lagoon outfall was normally greater than this, one of their technicians starting in 1974 apparently routinely made a 1:10 dilution but neglected to consider this in his final analytical results (Ex. 9 at 3). In addition, a single standard solution of 0.5 mg B/l was used every two months to recalibrate their spectrophotometer. Greater error occurs near the limits of detection (upper and lower). Most standard methods require systematic daily checks of the standard curve to assure accuracy (Ex. 13 at 4). In July 1976, IPC started splitting samples with ARDL Lab in Mount Vernon. They found their Baldwin Lab results ran about 40% lower than ARDL. This 40% correction was applied to the 48 samples from the Baldwin Laboratory (Ex. 9 at 5).

The amended IPC Boron analyses shown in Exhibit 14 (Appendix B-1) reveal values from 0.1 to 17 mg boron per liter. Values greater than 10 mg B/l during 1974 and 1975, a period during which some reported values were multiplied by 10, are somewhat suspect since such values would have exceeded the working range of the method even after the 10-fold dilution.

The Board regrets the absence of dependable analyses during the period IPC was utilizing Illinois Coal as these values would have been helpful in a selection of an appropriate standard. Dr. Schmulbach testified that utilizing worst case conditions a maximum concentration of 23.7 mg B/l could ensue (R. 44). The methods of calculation are shown as "Exhibit 1" appended to Exhibit 11. The values given therein are 23.3 for high sulfur coal (Illinois) and 10.0 for low sulfur (Colorado) coal. Drs. Muchmore and O'Brien also calculated this value and found 20.9 mg B/l for Illinois coal compared to 8.9 mg B/l for Colorado coal (Ex. 14 at 13). It is realized high rates of evaporation with long retention times in the ash pond could yield concentrations greater than these. IPC is presumed to have arrived at their proposed 25 mg B/l concentration based on Dr. Schmulbach's calculations.

The Agency states the use of IPC's analytical data prior to September 1976 to establish historical discharge levels is extremely inappropriate. They would therefore use only data collected by IPC after September 1976. Agency data for 1976 indicated a maximum value of 5.0 mg/l and a medium value of 3.1 mg/l. IPC data (DMR) from September 1, 1976 through April 31, 1977 showed an average value of 3.0 mg/l and a maximum value of 4.2 mg B/l (Ex. 12 at 3). The Agency recommends a concentration standard of 5 mg B/l.

Mr. Larry L. Idleman, Director of Environmental Affairs with IPC, testified that several developments were under way that could permit, or even require, the use of some Illinois coal. IPC has supported research on the Allis-Chalmers KILnGAS low btu coal gasification process and one of the five demonstration power plant locations under consideration would utilize the Wood River oil-fired units. If selected, the coal ash from the gasification process would go to IPC's ash lagoon (R. 156). The sulfur content of the Colorado coal might permit some blending with Illinois coal if appropriate equipment were added to the plant. In addition, every legislation may require retrofitting the present three oil-fired furnaces to burn coal (R. 157).

The Board finds that the risk of environmental harm in this very unique situation does not justify placing the boron standard so low that IPC may be precluded from using Illinois coal. With present operations and Colorado coal during 1976 the Agency shows a maximum concentration value of 5 mg/l. Drs. Schmulbach and Cox calculated this coal could give a maximum value of 10 mg/l and Drs. Muchmore and O'Brien in similar calculations report a value of 8.9 mg B/l. The above researchers calculated values of 23.3 and 20.9, respectively, if Illinois coal data were used in the calculations.

According to these calculations, the Illinois coal could give values about 2 1/3 times higher than the Colorado coal or concentration values of about 12 mg B/l under normal operations could be expected. IPC reported values up to 17 mg B/l during 1974 and 1975 while burning Illinois coal; however, the highest average value was 12.95 mg B/l (Ex. 14 at Appendix B-1). While the Board realizes IPC's analyses at that time were of dubious accuracy, they are the best estimates available and are reasonably in accord with values expected when the differences in boron content of the fuels are considered.

The following conclusions were reached in the economic study by Drs. Muchmore and O'Brien:

- a. Should the proposed change be denied additional estimated costs of \$272,000 capital and \$8,300 annual operating would be required by IPC for the next least cost alternative. No significant effect would be anticipated on the availability of goods and services, and the availability of employment.
- b. No discernible effect would be anticipated on Illinois agriculture or local government.
- c. The direct economic impact of the proposed rule change on commerce and industry would be minuscule. The secondary effect, in terms of attraction of new industry, is difficult to evaluate on a quantitative basis but should be given careful consideration. Actions on any proposed rule change affecting industrial operations would be expected to influence the attitude of industries contemplating expansion in Illinois.

In summary, it should be noted that the proposed rule change would preserve the status quo. Should the rule change be granted and evidence of environmental damage be disclosed at some future date, the cost of backfitting a pump-transfer line system to the ash pond discharge should not (except for inflation) be significantly greater than today's cost (R. 258-259).


In conclusion the Board finds that a boron concentration of 15 mg. boron per liter as a water quality standard in the streams (the unnamed tributary and Wood River Creek) below IPC's ash pond discharge point would have a minimal environmental impact on aquatic and terrestrial flora and fauna in and associated with these streams. Allowing this concentration will also provide IPC with an economical route to the Mississippi and in light of current energy concerns provide enough flexibility that Illinois coal could be used.

ORDER

It is the Order of the Pollution Control Board that an addition be made to Rule 203.1 of the Chapter 2: Water Pollution Control Regulations. A new subsection (b) shall be added to read as follows:

- (b) The boron limitation in Rule 203(f) shall be inapplicable in the unnamed tributary of Wood River Creek which enters Wood River Creek 4700 feet above the confluence of Wood River Creek with the Mississippi River from a point 450 feet above the confluence of the unnamed tributary and Wood River Creek to said confluence, and in Wood River Creek from said confluence to the confluence of Wood River Creek and the Mississippi River, and in lieu of the limitation in Rule 203(f), the boron limitation shall be 15 mg/l in the aforesaid waterways.

I, Christan L. Moffett, Clerk of the Illinois Pollution Control Board, hereby certify the above Opinion and Order were adopted on the 16th day of March, 1978 by a vote of 5-0.


Christan L. Moffett, Clerk
Illinois Pollution Control Board