Impact Analysis Of Electrical Transmission Lines

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The effects of Hydro Transmission Lines and their impact on real property and its occupants can best be described under three separate headings, namely: The visual impact; the physical impact; the psychological impact. Each of the above separate impacts will have specific but cumulative effects on the value of the residual property as well as on the people living on the land, and to assist in determining these effects, we have consulted and will quote from various publications, but more specifically from the following:

> Report of the Solandt Commission, TRANSMISSION, April 1975 *A Public Inquiry into the Transmission of Power between Lennox and Oshawa.*
>
> LOCATION HYDRO—Interdisciplinary Research, Centre for Resources Development, University of Guelph.
>
> *The Electrical Effects of High Voltage Transmission Lines,*
> Dr. E. Koczkur, P.Eng.
> James F. Maclaren Ltd.
>
> Report of the Solandt Commission, March 1974. *A Public Inquiry into the Transmission of Power between Nanticoke and Pickering.*
>
> The Socio-Economic Impacts of Electric Transmission Corridors—A Comparative Analysis Prepared for: The Royal Commission on Electric Planning, April 1978.

This article endeavours to detail and isolate the various impacts created by the intrusion of high voltage electrical transmission lines in rural and semi-rural areas by an examination of existing reports, studies and articles. It also attempts to correlate such impacts with public reaction through decisions and pronouncements of the courts.

We deal primarily with the new Ontario Hydro 500 KV lines under construction in the Province.

The Visual Impact

On pages 93 and 94 of the *Solandt Report*, there is a portion devoted to the problem of placing these huge 162-foot towers so that viewing them will not overwhelm the travellers on Highway 401.

The *Solandt Report* concludes that a comfortable viewing distance for a tall object is three times its height or in this case, 486 feet. The assumption is that at this distance the tower tends to blend in with the surroundings and although visible, it is not too objectionable.

While this assumption may be acceptable when applied to motorists travelling at high speeds on an expressway, it becomes unrealistic when the objects viewed are multiple towers and cables in a rural setting.

The conclusion reached in the *Solandt Report* is directly in contrast to the results reported in a *Study*, prepared by the centre for resources, University of Guelph. In the section which deals with the *Visual Impact of Hydro Transmission Lines*, the following statement appears:

> **Field studies in Kent County and other landscape types suggest that (at) between one and two miles, the tower begins to approximate foreground forest cover height and neither dominates nor contrasts the landscape. Exceptions to this occur when a tower or towers are skylined thus making the profile dominant for distances exceeding two miles. Studies completed in both summer and winter indicate that seasonable variation does little to affect these distances.**
>
> **The one to two-mile limit is generally confirmed by a French Study, as discussed by Van der Ham and Iding (1971), which suggests that the critical perceiving distance for apartment buildings in flat landscapes is approximately 1,400 metres.**

In the course of our research concerning the visual impact of Hydro Transmission Lines on the environment, the general public and more specifically on those people living under, around, or within sight of Hydro Transmission Lines[1], we have consulted the *Study*, titled, *Location Hydro—Interdisciplinary Research Centre for Resources Development University of Guelph.*

[1]Hydro Transmission Lines referred to in this article are electric transmission lines belonging to Ontario Hydro.

In the preface to this Study, the following appears:

> **The information provided in the following pages is the result of work undertaken by a team of Agricultural and Resource Economists, Landscape Architects, and Land Resource Scientists from the University of Guelph.**
> **The team set out to make an independent study of the effect of overhead transmission lines on the environment and how to minimize this effect.**

The research for this study was completed in 1974 after a two and one-half year period, and the study was published soon after. There are a number of definitive statements in the *Study* concerning the visual impact of Hydro Transmission Lines and installations on the environment, which in my opinion are applicable.

In the introduction to the section titled *Visual Impacts and Their Evaluation* there is a definition of *Visual Impact* as follows:

> **Visual Impact may be defined as: *a perceivable physical change* to the landscape, that results in *a negative human response.* The definition breaks the study of visual impact into two basic parts; the first dealing with the perceivable visual change and the second considering the resultant human response.**
>
> **A change in the visual landscape is initiated by the perceptible addition and/or removal of elements in the landscape. With specific reference to Hydro-Electric power**

transmission as a land-use, additions would include towers, the lines they support, and stations for generation transmission and distribution. Elements commonly removed by Hydro installations are forest cover, agricultural crops and occasionally buildings and other man-made structures. These all result in perceivable physical changes. The degree of change is not constant, but varies according to characteristics of both the installations and the landscape in which they occur.

Such changes, or even anticipation of them, can elicit human response. The negativity of the response is implied by the very use of the term impact. It is defined as a forceful collision of contact but, since the onset of widespread environmental awareness, it has come to mean *the adverse* effect of the forceful collision between the environment and the technology of man.

Written and verbal submissions to recent line location inquiries clearly demonstrate that people are reacting negatively to the imposition of Hydro lines in the landscape.

For the purpose of this study a modified but more specific definition is required. Since Hydro is not a space defining element the critical perceiving distance is the distance at which a transmission line no longer influences the visual experience either by dominating or by contrasting with the perceivable landscape. This is not to say that a hydro line cannot be seen beyond the critical perceiving distance, rather when it is seen it plays only a minor role in its visual experience.

The visual effect of transmission lines on the environment is noted below:

> The intrusion of transmission lines into such landscape is particularly disruptive because the visual harmony and pleasant variety that follows from wise use, is greatly diminished in consequence. There is harsh function, materials, and form incompatibility.

Elsewhere in the *Study* concerning a method of valuing the visual landscape, the following statement appears:

> To understand how people value the visual landscape, one must look upon it as a *natural resource*. However unlike other natural resources such as minerals, timber or soil, the visual resource is *exploited* but not diminished through the act of viewing it. Furthermore, the value of the resource cannot be successfully determined by market value since it is not bought and sold. Although the sale of some properties may include a value for the visual resource, economics has yet to be proven a reliable indicator. Other methods must be devised to determine and monitor value.

From the above, we conclude that there is indeed a negative influence on the environment and on the visual aspect of the landscape which translates into a loss in value.

The visual impact on the residual land after a transmission line taking and on the people living on the land is a result of the use of the land for electric transmission lines.

I have long been of the opinion that the intrusion of a high voltage transmission corridor has the effect of reducing the market value of lands adjacent to such a facility.

In the past, unfortunately, individual expropriated landowners have either been unwilling or financially unable to subsidize the cost of research of sufficient scope to support this opinion. However, a study to examine and determine the long-term social and economic impacts of transmission lines was recently undertaken by the Department of Man-Environment Studies, Faculty of Environmental Studies, University of Waterloo, to follow a similar paper presented in 1976 to the Royal Commission on Electric Power Planning.

This study entitled *The Socio-Economic Impacts of Electric Transmission Corridors—A Comparative Analysis,* was published in April of 1978 and submitted to the Royal Commission on Electric Power Planning.

Although this study covers a wide range of impacts, for the purpose of this report, we have included excerpts which deal directly with reduction in the market value of lands adjacent to transmission corridors.

The following excerpt from the summary of the study describes its purpose, the methods used to obtain and analyze data, and some of the general conclusions.

SUMMARY

1. The purpose of the study was to examine the long-term social and economic impacts of a 500 KV and a 230 KV transmission line. The lines studied were the 500 KV line between Essa and Kleinburg and the 230 KV line between Essa and Orangeville. The lines are of different age, voltage and physical size. An attempt was made to identify the influences of these factors on social and economic impacts. Control lines were identified one mile to the east of the existing line (Chapter 1).
2. A review of the literature dealing with the social and economic impacts of transmission lines was undertaken. The review includes a number of studies done for utility companies throughout North America (Chapter 2).
3. The physical characteristics of the lines and controls were analyzed. Comparisons were made between each line and its respective control and between the study area. No significant differences were found between the lines and their respective controls but some differences between the study areas were noted (Chapter (Chapter 3).
4. A total of 1,007 sales of properties on both lines and controls during the years 1967-77 were analyzed. Data from Regional Registry Offices was used to examine patterns of frequency of sales and average price per acre for different sizes and types of property. During the 1967-77 period, fewer properties of less than 10 acres and more properties of 10-50 acres were sold on the lines than on the controls. Properties over 150 acres sold with similar frequency. The

500 KV line showed an increase in sales during the period of land acquisition for the corridor right-of-way but otherwise the frequency of sales on both lines and controls fluctuated in similar patterns with the general activity of the real estate market. Properties on the lines have consistently lower average prices per acre than properties on the control. Prices were lower by 16-29 percent with the largest depreciating effect on small properties and a decreasing effect for larger properties (Chapter 4).

A further conclusion which appears in this opening summary, is—*The most significant and continuing impact perceived, appears to be the effect of the presence of the corridor on the market value of property.*

The study, is a lengthy document which touches on all aspects of socio-economic impact. We, however, are primarily concerned with the economic impact and its effect on the market value of the land adjoining electric transmission corridors. Accordingly, we have selected excerpts from Chapter 4, titled, *The Effects of Transmission Corridors on Real Estate Transactions*, and Chapter 8, titled, *Summary and Conclusions*.

The introduction to Chapter No. 4 reads as follows:

Chapter 4.

The Effects of Transmission Corridors on Real Estate Transactions

Introduction

An examination of previous reports has shown that although the question of the impact of Hydro transmission lines on real estate values has been raised and studied many times using various methods, the nature of the impact has not been conclusively established. Generally, there is a lack of scientific data and much of the reasoning in past reports has been based on hearsay or small sample sizes. By using a large sample and statistical analysis techniques, some conclusions can be drawn as to the actual effects on agricultural and estate-residential properties in the study area.

The following excerpt illustrates the differential between the price per acre of land impacted by a transmission corridor as compared to the *Control* lands approximately one mile distant from the Hydro corridor.

The comparisons are drawn between three categories of land; small, under 10 acres; medium, 10 acres to 49 acres; large, 50 acres or over. As indicated, Table 4.6 applies to a 500KV study area, and Table 4.7 to 230KV study area.

Table 4.6

Average Price/Acre by Size Category—500KV Study Area

	500KV Line	500KV Control	Line vs. Control
Small (under 10A)			
Frequency	96	141	
Av. Price/A($)	30,024	42,300	-29.0%
Medium (10–49.9A)			
Frequency	158	104	
Av. Price/A($)	1,340	1,832	-26.9%
Large (over 50A)			
Frequency	57	70	
Av. Price/A($)	679	881	-22.9%

A comparison of the figures in Tables 4.6 and 4.7 for each line and its respective control, shows some rather striking findings. Averaged over a large number of sales, the price per acre of properties on the line was consistently lower, ranging between 16.9 percent and 29.3 percent lower than control prices. Results were surprisingly consistent between the 500KV and 230KV study areas.

These results are in sharp contrast to the findings of previous studies of this type which found no substantial decrease in value attributable to transmission lines. The number of transactions considered in this study, however, was much larger than in any previous research. *This enlarged data base increases the reliability of the finding that transmission lines do, in fact, have a depressing effect on the market value of affected properties.*

Contrary to the findings of previous research, this study indicates that the market value of property is depressed by the presence of a transmission corridor. The actual measure of the depreciating effect, however, has not been conclusively established by this research. *When all the factors discussed above are taken into account, it might be suggested that the calculated effect, ranging from 16 to 29 percent is somewhat inflated. However, it is felt by the researchers, that even if the magnitude of the depreciating effect has to be lowered by several percentage points to better reflect reality, the market value of properties affected by transmission lines is significantly lower than properties at a distance from the line. Properties of all sizes are affected with the impact being most strong on small and medium sized properties. This would indicate that residential estates and hobby farms are more strongly affected than are commercial farms.*

Table 4.7
Average Price/Acre by Size Category—230KV Study Area

	230KV Line	230KV Control	Difference Line vs. Control
Small (under 10A)			
Frequency	61	79	
Av. Price/A($)	17,554	24,844	-29.3%
Medium (10–49.9A)			
Frequency	85	69	
Av. Price/A($)	1,236	1,682	-26.5%
Large (over 50A)			
Frequency	48	44	
Av. Price/A($)	956	1,147	-16.7%

Small properties (under 10 acres) appear to be the most strongly affected by the presence of the line with prices per acre being 29.0 percent lower on the 500KV line and 29.3 percent lower on the 230KV line than on their respective controls. Large properties (50–99.9 acres) appear to be almost as strongly affected with prices per acre 26.9 percent lower on the 500KV line and 26.5 percent lower on the 230KV line. There seems to be less of an effect on properties over 100 acres and a greater difference between study areas. Prices per acre were 22.9 percent lower on the 500KV line and 16.7 percent lower on the 230KV line as compared to their respective controls.

And in the chapter titled *Summary and Conclusions* the following significant statement is made:

> **There appear to be four main areas of continuing social impact. The strongest of the impacts appears to be the effect of the presence of the transmission corridor on the market value of affected properties. The analysis of real estate transactions (Chapter 4) indicated that transmission corridors do, in fact, depress the market value of the property by about 15 to 30 percent depending on the size and type of property.**

An analysis on the effect of transmission lines on residential properties in urban areas was also completed in Illinois by P.F. Colwell, Professor of Urban Economics at the University of Illinois and by K.W. Foley of Illinois Power Company and published under the title, *Electric Transmission Lines and the Selling Price of Residential Property.*

This study dealt with residential subdivisions that had been built after the construction of a power line. The study employed a complicated analysis formula applying 10 variables.

> **The approach of this article has been to abandon all references to specific compensable elements of damage. Such references tend to generate more heat than light. Subjective opinions as to whether or not each element contains a significant amount of damage are useless. This article uses distance to the transmission line as an objective index of the extent of damage. Therefore, without reference to the specific elements of damage, it is found that there is a significant reduction in selling price relative to proximity. . . .**
>
> **A sample of 200 single-family housing sales was assembled for this study. These sales represent more than a decade of transactions near an electric transmission line in two neighbourhoods of Decatur, Illinois. An equation was developed that relates selling price to 10 explanatory variables. This equation or model reflects reasonable hypotheses concerning the impact of the transmission line but, for the most part, it reflects accepted appraisal principles. The estimated model indicates that selling price tends to increase at a decreasing rate as distance to the transmission line increases.**
>
> **The primary conclusion of this article runs counter to existing doctrine. It is shown that proximity to an electric transmission line is associated with diminished selling prices. Every situation, of course, is different. But the extent of the differences that do exist will not be evident until a number of similar studies are undertaken.**

Where the authors found their *existing doctrine* except as a stance adopted by Power Companies, is difficult to discern since the U.S. Courts have been granting compensation for visual damages for some time.

In Re *Hicks Vs. United States* the head note reads:

> **In proceeding by Tennessee Valley Authority to condemn easement strip across farm for erection of steel towers for power lines damages done to esthetic values should be considered in determining damages.**

The United States Court of Appeals Chief Judge Allen said in this decision of May 13, 1959:

> **The land was conceded to be a beautiful property. The damage done to the residue of the land over and above the easement strip included damage to esthetic values. See *Ohio Public Service Company v. Dehring*, 34 Ohio App. 532, 172 N.E. 448, which held that the unsightliness of towers and transmission lines may be considered in the award of damages for taking of farm land for a right-of-way for power lines, as unsightliness might affect the value of the land. *Texas Power & Light***

> *Company v. Jones*, Tex. Civ. App., 293 S.W. 885. Cf. *Fain v. United States* ex rel. Tennessee Valley Authority, 6 Cir., supra, 145 F.2d 958.

The cases cited are even older. In the *Ohio Public Service Co. vs. Dehring*, the Court of Appeals of Ohio in May of 1929 dealt with an appeal by Ohio Public Services Co.:

> By request No. 4 the plaintiff sought to establish the principle that the unsightliness of the towers and transmission lines could not be considered by the jury. We think that this request was properly refused, for the reason that unsightliness, which affected the value of the land, was a proper element for the jury to consider in determining damage to the residue.

In *Texas Power and Light Co. vs. Jones*, Looney J. of the Court of Civic Appeals for Texas dealing with the Appeal of the Texas Light and Power Co. said in March of 1927:

> 3. Appellant further contends that the court erred in overruling its special exception to that portion of the defendant's answer in which he alleged as an element of damages that the power line, consisting of poles, wire, etc., was an unsightly object that marred the beauty of the place. The proposition urged is that a diminution in value in land from such cause is not a *damage* within the meaning of the Constitution.
>
> We cannot accept this view. The statute contemplates that on a hearing of this kind evidence may be introduced as to all damages which will be sustained by the owner by reason of the condemnation. If it be true, as alleged, that the power line with its poles, crossarms, wires, etc., is an unsightly object, disagreeable or repellent to sight, its presence would naturally have a tendency to affect adversely the market value of the land. Therefore we find no error in the ruling of the court as complained of in this assignment.

A rehearing of this Appeal was denied in April 1927.

The conclusion seems inescapable, that people respond negatively to such visual impacts and market value suffers accordingly.

This author in co-operation with a firm of engineers and planners was invited to tender to Ontario Hydro for an indepth study in Ontario, of the effect of electrical transmission lines on property values. The tender has been awarded to some other group and we are apprised the results may be available within a year and a half. It is to be hoped that some definitive data will emerge.

The Physical Impact

The most obvious and direct physical impacts on any property as a result of the expropriation, are the value of the land taken; the effect of this taking on the residual land, and the effect on farm income.

In addition to these, there are other impacts, which can and do have an effect on a farm and the person operating that farm. These impacts are more fully described in Section 5 of the aforementioned *Study*, titled, *Impact of Transmission Lines on Agriculture*, and excerpts from this section are quoted below:

> Since bulk power transmission is a rural form of development, it is that sector of the community which lives in the non-urban areas of the province which will absorb the greatest portion of the direct impact of transmission lines. Most of the people who live and work in rural areas are involved in agricultural production. It is in the area of agricultural impact of transmission lines that this section is directed.

The *Study* continues with the following:

> The impacts on agriculture which do exist and which are of considerable concern to all agriculturists are those related to the losses suffered by individual farm operators upon whose land the transmission facility must be built. This individual must bear the direct impact of the line by living and working with it (or around it as the case may be) for the duration of his association with the land involved.
>
> For many, the solution of the problem can be summarized in one word, *compensation*. For others it is a much more complex problem than one which can be solved by doling out money to overcome the losses related to time wasted in operating around towers, to the crop losses from the area and interference in normal operations around towers, or to compensate for the potential hazards or the numerous headaches which go along with the inclusion of hydro on farm property. For many farmers the permanent installation of a major transmission corridor across their property is a highly undesirable intrusion of urban development which cannot be totally compensated for regardless of the level of compensation offered.
>
> Compensation can no longer be considered as the placebo for agriculture. Consideration in transmission location planning can be the only permanent solution to the problem.

The following is an excerpt from the *Study* prepared by the University of Guelph, which identifies in general terms, losses in agricultural productivity associated with a power transmission facility:

> There are a number of components of impact which related to a loss in the productivity (here defined in terms of crop yield potential) of agricultural lands which are associated with a power transmission facility. These include: Land lost at the tower base; reduced crop yields resulting from the injurious effects of construction on the soil profile and drainage; reduced crop yields resulting from tower interference in normal field operational patterns; reduced crop yields resulting from weed propagation under towers.

Concerning land lost at tower base, the *Study* concludes that the percentage of land lost is minimal and would not be more than one-half acre per 100-acre farm.

Referring to reduced crop yields resulting from the injurious effects of construction, the *Study* makes the following statement:

Damage to the soil in the area around the tower base in the form of soil compaction from heavy construction equipment, erosion from exposed soil surfaces, and burial of topsoil with relatively unproductive subsoil materials from tower footing excavations, can result in prolonged damage causing a reduction on productivity.

Damage to tile drainage and surface drainage including intermittent streams, ditches and microdrainage features may result from the operation of heavy machinery and the alteration of existing grades.

The severity of the damage will vary with weather and site conditions. Generally, construction activity involving the disturbance and/or removal of existing vegetation will cause the most severe impact in the wettest periods of the year which usually correspond to snowmelt and spring rain periods from March to mid-May.

The question of reduced crop yields from the tower interference in normal field operational patterns is discussed in the *Study* as follows:

> The area of machinery overlap around the tower base is largely dependent upon the size of machinery being used. Estimates have been made that up to 50 feet of land on all sides of the towers will be affected by crop losses related to overlap and inefficient machinery operation due to trends toward the use of very large machines. Factors reducing crop yield related to machine course alteration at the tower include: Overlapping of field applications of seed and fertilizers results in the detrimental lodging of the crop; overlapping of post seeding operations (including harvesting and weed cultivation) results in damage to the standing crop; overlapping of spraying operations will result in the build-up of concentrations of spray residues which may reduce productivity; loss of actual harvest yield from the inefficient pick up and/or *harvester overshoot*.

The severity of this element of impact on productivity in terms of the size of the area around each tower which is affected and in terms of actual yield losses is undetermined at this time.

The possibility of reduced crop yields resulting from weed propagation under the towers is referred to in the *Study* as follows:

> Uncontrolled weed growth under the tower will contribute to the problem of weed control over cultivated areas beyond the tower base. Effective control of this problem is feasible under a weed control program which includes regular cutting and spraying of weeds under each tower. Hydro could undertake such a program or could pay the farmer for weed control measures required under towers located on his property.

The possibility of reduced efficiency in agricultural operations is dealt with in the *Study* in the following portion:

> The impacts described in Section 5.3.1 pertain to the permanent loss in productivity of the land resource base. Other impacts, such as, the time loss, inconvenience, and the potential hazards imposed by the individual towers, are considered to reduce the efficiency of and the level of returns received by individual farms.
>
> Efforts at improving farm efficiency through the use of large machinery or, in cash crop areas, by the removal of fencelines and hedgerows is an indication of the overall agricultural trend towards increased efficiency. The presence of a multi-line power transmission facility may greatly reduce the operation efficiency of machines in the right-of-way. Estimates of the increased costs of contractual work for farm machinery in fields having a large number of towers range from three to seven dollars per acre.
>
> Interference with certain forms of crop irrigation has also been identified by the agricultural sector.
>
> Aerial operations involving the application of fertilizers and sprays are also affected by the presence of a line. The major concern here is the potential hazard which a line presents to aerial operations. Hazards on the ground are also of concern to farmers in regard to the potential personal injury and equipment damages resulting from contact with towers during field operations. This is especially of concern with night operations. Liability for tower damages presently rests with the farmer.

The American Courts have been adjudicating on these problems for some time. In *Texas Electrical Service Company vs. Etheredge*, an appeal by Texas Electric to the Court of Civic Appeals of Texas, from the County Court in April of 1959 it was noted that:

> Inconvenience in cultivation caused by condemnation of a power line across farm property is an element that may be considered in assessing damages, as may also be the inconvenience suffered by the landowner because his fields are cut in two.

Physical effects are readily discernible and can therefore be determined with some reasonable accuracy although there has been a tendency to minimize the long term effect on agricultural productivity.

Editor's Note: The second portion of this article will cover the psychological impact of high voltage transmission lines on those living near them. This second part will appear in the December issue of *Right of Way*.

About the Cover

This 1888 bridge at Sioux City, Iowa, will be replaced by a 1,465 foot bridge to be completed in late 1981. The photo is provided courtesy of Burlington Northern.