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## **GOLD MINING – ENVIRONMENTAL STIGMA OR PROPERTY VALUE ENHANCEMENT**

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### **ABSTRACT**

*Waihi Gold Company has been operating the Martha mine at Waihi, New Zealand since 1987, firstly under a licence approved on 16 July 1987, issued under the Mining Act 1971 and then under an extension granted in 1998 by the Environment Court, approved under the Resource Management Act 1991. Surface mining activities at Martha are due to cease in 2007. An application for underground mining known as Favona Project at Waihi is in the final stages of approval. That application is to extend mining activities at Waihi until 2015.*

*Opponents to mining activities, particularly surface mining at Martha, have argued a decrease in property values as a result of environmental stigma, among other adverse environmental effects.*

*Case study research on comparative residential property sales activity was undertaken to test the veracity of opponents' claims that real estate property values have been influenced by environmental stigma.*

*The authors compared the sales data for houses and vacant residential land at Waihi with the two neighbouring towns of Paeroa and Te Aroha over a 22.5 year period from December 1980 to June 2003, concluding that there has been a positive property value effect, a 'value enhancement', 'valenhance' on housing and vacant residential land values at Waihi as a direct result of the gold mining activities. Their findings support the conclusions of TelferYoung(Auckland) Limited (TelferYoung), property advisors and registered valuers. Peter Young of TelferYoung gave evidence at hearings in support of Waihi Gold Company. The positive overall effect on residential property values at Waihi may also have exceeded any potential detrimental environmental stigma effects on properties immediately adjacent to the mining.*

## **INTRODUCTION**

The Waihi Gold Company mine is part of the Hauraki Goldfields, a total residual resource estimated in 2004 to be 20 million ounces of gold and 87 million ounces of silver valued at \$23,863 million (Environment Court 2004). Historically, Waihi's gold strike began in 1878 and a year later William Nichol pegged out a five-acre claim and named it 'Martha' after a relative. By the mid 1880's the mine was thriving and, over its life until 1952, produced 5.5 million ounces of gold and 38 million ounces of silver by underground mining. Martha closed in 1952.

Waihi Gold Company re-established surface mining activities at Martha in 1987 and has become a significant economic contributor to the Waihi community and New Zealand (Wheeler 2003). The original application for a mining Licence under the Mining Act 1971 was approved on 16 July 1987 with mining operations commencing in 1988 and due to cease in 2000. A second application in 1997 was made under The Resource Management Act 1991 to extend mining activities until 2007. Environmental Court approval was obtained in 1998.

Opponents of mining applications at Waihi since the 1980's have cited property value loss among environmental concerns. The most recent opposition has been to Favona Project at Waihi. However, submitters in support of Favona Project also stated that the positive effects of mining would outweigh negative impacts. Favona Project will extend activities

in the Waihi area until 2015/2016, and is anticipated to maintain employment levels in excess of 200 persons from 2002, as Martha diminishes in importance. Numbers will decline from 2005 to an approximately 140 person workforce at the lower level of output by 2015, when Favona Project ceases operations (Wheeler 2001).

A detailed historical consideration of the effects of gold mining activities on residential property values at Waihi is relevant given that there is the possibility of future gold mining applications at other locations within the Hauraki Goldfields, notably on the Coromandel Peninsula 40 - 50 kilometres north of Waihi. The interim decision of the Environment Court on 30 July 2004, under appeal, required amendments to the Thames Coromandel District Council (TCDC) Proposed District Plan 'Decisions Version' to allow gold mining to be reclassified as a discretionary activity or a non complying activity in certain zones, where formerly it was a prohibited activity (TCDC 1999). The interim decision overturns the absolute prohibition on mining activities in most locations on the Coromandel Peninsula, a result successfully achieved for the Coromandel Peninsula community in the 1980's by environmental groups referred to as 'Coromandel Watchdog' or 'Peninsula Watchdog'. Their notable success in the 1980's, was the prohibition of mining on Crown land north of Kopu, near Thames.

The authors have examined the environmental effects of the Waihi Gold Company activities as measured by residential property value movements at Waihi over the 22.5 years period from 1980 to 2003, being 7 years prior to recommencement of mining activities and the 15.5 years since 1987. Residential sales data for established housing and vacant residential sites were studied over the 22.5-years period, comparing Waihi to Paeroa and Te Aroha -- two nearby residential towns unaffected by the mining activities.

Although prospecting recommenced in 1979 the more important dates to note possible changes in the data were 16 July 1987 when the first mining licence was issued and 1988 when the Martha mine operations recommenced, although as operations built up the effect on residential property values would likely have occurred over a longer period. The approval of the mining extension in 1998 might also be considered an important date, as the mining activity was otherwise to cease in 2001.

## RESEARCH OBJECTIVES

The overall objective by case study analysis was to determine if gold mining activities at Waihi created environmental stigma to its surrounding residential community, as measured by changes in residential property values that did not apply at the two nearby towns of Paeroa and Te Aroha.

There were two aims of the study:

Firstly, to identify and if possible draw conclusions from the trend in residential property prices for Waihi, Paeroa and Te Aroha over a 22.5 years period from December 1980 to June 2003.

Secondly, to determine whether environmental stigma applied at Waihi as measured by changes in residential property values.

Null Hypothesis.  $H_0$

The Null hypothesis to be tested is:

*Environmental stigma has occurred at Waihi as a result of gold mining activities as measured by an adverse effect on residential property values.*

In the event that the Null hypothesis is not supported by the case study research then there is good evidence to support the alternative Hypothesis  $H_a$ .

*The mining activity which recommenced at Waihi in 1987 has had a positive impact on residential property values*

Or,

*'Environmental valenhance' has occurred at Waihi as a result of gold mining activities as measured by a positive effect on residential property values.*

## **BACKGROUND**

R. Peter Young, of TelferYoung undertook an assessment of sales data over time and concluded that values in Waihi had increased and at a greater rate than at Paeroa and TeAroha since the mining operation recommenced in 1987, compared with the movement in property values for all three residential communities prior to 1987. A study was also undertaken by Wheeler (2001) who concluded that mining operations are an integral part of the local surrounding economies, with economic dependence on these operations and their spin-off being relatively high. Young considered that with the economic effects of mining on the Waihi urban area, it was no surprise that residential values within the Waihi urban area have increased, and that economic benefits to Waihi are likely to extend beyond 2007 when the Waihi Gold Company mine is projected to close and Favona Project continues.

The subject research has involved a detailed consideration of all residential sales data for the three towns since 1980. Independent data collation and verification was undertaken on population and dwelling occupation statistics. Personnel of Matamata Piako District Council and Hauraki District Council were interviewed to identify, and if possible confirm, economic events that might have negatively or positively influenced residential property values . The hard copy and electronic archived files of TelferYoung were made available to undertake the research.

Attempts were made to extend the study by an analysis of building permits/consent applications for new dwellings and property improvements, as measured by number and value for all three towns, but this could not be completed on a rigorous basis. The available data did not provide an accurate match over the entire time frame.

## **LITERATURE REVIEW**

### **Planning**

The TCDC in its Proposed District Plan, Decisions Version, classified mining in all zones of the Coromandel Peninsula as either a prohibited or a non-complying activity (TCDC Proposed District Plan 1999). This was appealed by the Ministry of Commerce (1998) and The New Zealand Minerals Association (1998). The interim decision of the New Zealand

Environment Court, requiring gold mining to be reclassified as a discretionary activity or a non complying activity for certain zones of the TCDC Proposed District Plan may encourage applications for gold mining activities on the Coromandel Peninsula (Environment Court Interim Decision 2004, Kiriona New Zealand Herald 2004). The interim decision is under appeal to the High Court (TCDC 2004) and will be heard in 2005.

## **Stigma**

Stigma in its most literal original sense arises from the Christian reference to the characteristic distinguishing marks "...corresponding to those left on Christ's body by the Crucifixion..." (Oxford Concise English Dictionary 1995) and the term was not necessarily intended to be a word considered only as a negative or adverse effect. Such a definition allowed a positive connotation, which in modern parlance no longer applies. Stigma has no antonym. Stigma in a general sense, may be referred to as: "...something that is to be shunned or avoided not only because it is dangerous but because it overturns or destroys a positive condition, signalling that what was or should be something good is now marked as blemished or tainted" (Kunreuther et al 2001).

When used in relation to property, the term stigma is not used consistently. Various definitions have emerged relating to types of stigma. Chalmers and Roehr, (1993) in extending the work of Pachin (1992) refer to stigma as "...the impacts on value stemming from the increased risk associated with the property and the effect of this on marketability and financeability." Examples of stigma, likely to have an impact on property value, include noise, soil contamination, dust, water contamination, aesthetics and land stability.

Public perception is recognised as an important factor in the assessment of property value. "...all the factors that have an influence on a property's desirability and therefore its value are traced back to the market's perceptions..." "...needs, tastes, fears, sensitivities, desires and anticipations..." (Bell 1999),

Chan provided a definition that reinforces the 'risk' and 'market perception' elements of stigma : "Stigma is a value loss to property value due to the presence of a risk perception-driven market resistance" (2001).

Bond deals with measurements and remediation of stigma and provides the following detailed explanation in a footnote to a paper on ex-contaminated land: “‘Stigma’ is the blighting effect on property value caused by perceived risk and uncertainty. Uncertainties relate to negative intangible factors such as: the inability to effect a total ‘cure’; risk of failure of the remediation method; risk of changes in legislation or remediation standards; difficulty in obtaining finance, or simply a fear of the unknown.” Bond provides terminology relating to ‘Post-remediation stigma’: “‘Post-remediation stigma’ is the residual loss in value after all costs of remediation, including insurance and monitoring have been allowed for. It equates to the difference in value between a remediated site and a comparable ‘clean’ site with no history of contamination” (2001).

A commonly applied definition of stigma as it relates to property value effects is that outlined in the discussion on Leaky Home Stigma by Hargreaves & Shi citing a number of references: “A residual loss even after the completion of necessary repair as a result of increased risk or uncertainty regarding future events” (2004).

Although these descriptions of stigma relate to effects on ‘an environment’ in one sense or another they do not specifically refer to ‘the environment’.

Hofbauer & Ryan (2004) examine cases, focussing on stigma damages in situations involving construction defects and environmental contamination, where diminished value caused by a negative perception of a site results in compensation for the stigma - thereby satisfying the fundamental concept that an ‘injured’ party must be made whole. A noteworthy early case concerning the environment was reported on by Conger (1968). The case involved damages being sought for such factors as noise and lights, resulting from the effect of air flights over residential areas surrounding an airport.

Hofbauer & Ryan also note that the public perception underlying the stigma may be unsubstantiated or unreasonable and formed purely in reaction to publicity (2004). Specific terminology has emerged, such as ‘technological stigma’ - with the modern world’s concerns about human health and ecological risks, the press and other successful communications media assist to ‘spread the word’ about such risks, thereby imposing demands on societal decision makers (Kunreuther et al 2001).

The term 'environmental stigma' has received considerable attention in the Appraisal Journal of the American Society of Real Estate Appraisers, centring around contaminated property valuations, including reference to case study analysis, the 'detrimental conditions Matrix' and 'proximity stigma' (Jackson 2004, 2003(2), 2002, Wilson 2004, Siemens 2003, Anderson 2001, Roddewig 2000).

A consideration of environmental stigma in valuation terms inevitably leads to analysis, to determine if there is a residual loss expectation.

Jackson quotes from the Standards Board (ASB) and advisory opinion (AO-9) of the American Society of Real Estate Appraisers, Table 2:

"The Real Property That May Be Impacted by Environmental Contamination". Table 2 includes a recital of 'Specialized Terms and Definitions' including: Environmental Stigma, defined there as: "An adverse effect on property value produced by the market's perception of increased risk due to contamination. (See Environmental Risk, above)".

Environmental Risk is defined as: "The additional or incremental risk of investing in, financing, buying and/or owning property attributable to its environmental condition. This risk is determined from perceived uncertainties concerning: (1) the nature and extent of the contamination; (2) estimates of future remediation costs and their timing; (3) potential for changes in regulation requirements; (4) liabilities for cleanup (buyer, seller, third party); (5) potential for off-site impacts; (6) other environmental risk factors, as may be relevant" (Jackson, 2003).

On the matter of environmental stigma determination the ASB is cited in Jackson:

"AO-9, Line 177 opinion cautions that the analysis of the effects of increased environment risk and uncertainty on property value (environmental stigma) must be based on market data, rather than unsupported opinion or judgment..." Methods of consideration include 'paired sales' analysis, multiple regression, control area analysis and proximity analysis, noting the possibility of multiple adverse influences and scoring (2003).



The most recent definition of stigma that tends towards bringing these considerations together is: “Stigma is a detrimental impact on the market value of a contaminated property due to market perception of environmental health risks and possible future legal and financial liabilities” (Chan 2004)

The discussion on stigma and what it means or could mean has been outlined in some detail to indicate that the terminology as it affects property is in a state of flux but, understandably, has a wholly negative connotation. Absent from any of the definitions or terminology is an admission of the possibility that an enhancement in property values may arise from an environmental activity. The definitions of ‘stigma’, ‘environmental stigma’ and ‘environmental risk’ do not admit of a positive outcome. An alternative definition of a beneficial outcome from activities that effect the environment is therefore appropriate. Effects based considerations should be neutral and admit of both negative and positive outcomes. In the absence of a definition the authors postulate the, admittedly, inelegant phrase ‘environmental valenhance’ in the event that the research indicates that gold mining activities are capable of creating positive residential property value environmental effects.

**‘Environmental valenhance’** as outlined in this paper means:

“A beneficial residual effect on property value produced by the market’s perception of reduced risk due to a change to the environment causing economic benefits that outweigh the negative impact of environmental stigma”

Such a definition is akin to but not the same as the term betterment that may apply as a result of public works (Public Works Act 1981) defined as “...enhanced value (of real property) arising from local improvements” (Oxford English Dictionary, 1995), There are no local improvements with a mining activity such as those contemplated as a public work.

## **Mining Activity Research**

Information has been readily available to the public over the years, by way of Council commissioned reports, newspaper reports and publications. An example of the information available is set out in Newmont mine commissioned economic and valuation studies, a web site with information, (Newmont 2004).

Negative publicity may cause a sharp fall in the value of the property (Siemens 2003, McCluskey & Rausser 1999). One example of the role of the press providing particularly good reason to be wary of stigma damage is the unsupported article in the Jakarta Post (Indonesia) which reported on the government launching an investigation into 'gold mining giant Newmont Mining Corporation' following reports that its operation had caused Minamata disease. A distinction must be made between scientifically assessed risk and perceived risk. The Waihi Gold Company case study is an example where the general perception by residents initially was that the mine would have detrimental effects, whereas market based research may indicate the opposite.

Limited research has been accessed from the World Wide Web on environmental stigma having a possible negative effect on property values and the employment rate (Panhandle Health District, 1997, Coffin 1997, Hopey 2002).

Research carried out by Coffin & Sherwood for potential inclusion within an Environmental Impact Statement (EIS) highlighted the distinct lack of information on the issue of mining and its effects on property values. Supporting this claim, they describe how a number of real estate agents were contacted and none were able to identify a clear example of a mining operation having measurable effects on residential property values. Likewise, a consulting geologist, someone involved as a consultant with numerous mining operations, has never had a clear-cut case of existing or proposed mines having a measurable effect on residential property values. Coffin & Sherwood also report there being no evidence found in the marketing of homes in the residential area known as Fryeland, which is in close proximity to a mining operation, that the existence of this active mining operation had an effect on residential property values. A lake was constructed and the mining operation was not found to have a discernable effect on property values, but rather the presence of the lake appeared to have enhanced the marketability of the area. (1997). This may be of significance at Waihi in the future, as a lake is the final restoration process for the Martha mine site covering an area of 29 hectares. The lake should be filled by 2012.

Regression of sales data is recognised as a valid method of determining if environmental stigma applies (Jackson 2003, Chan 2004).

The literature discussion has identified the lack of consistency in definitions of stigma and environmental stigma as it affects property and their imprecision in the field of real estate research. The referenced terminology for stigma and environmental stigma presuppose a residual adverse outcome for research on environmental effects, which is scientifically an unreasonable position without admitting the possibility of a residual positive effect, however unlikely this may be from an intuitive perspective. Rather than add a further definition of stigma the authors propose an inverse definition to the terminology of the Standards Board of the American Society of Real Estate Appraisers, the terminology of Environmental Valenhance that recognises a potential positive outcome, noting that there is no conclusive evidence that mining has a negative impact on surrounding residential property values.

## **RESEARCH METHODOLOGY**

### **Data Collection and Demographic Effects**

Mining activity recommenced at Waihi following the Licence granted to Waihi Gold Company on 16 July 1987. Data on sales of residential properties were collated at 6 monthly interval over a 22.5 year period from 1980 to 2003, a time period that includes 7 years sales data prior to mining recommencing and 15.5 years since recommencement, approximately 16 years after the activity would have been in the 'market perception'.

Sales data were accessed through TelferYoung who retained original sales records data obtained from Valpak and Headway Systems accessed from the Local Authorities, who have an obligation to collect and record all sales transactions. The data collected included both single unit dwelling prices and vacant residential section prices for all properties sold over the 22.5 year period. House purchases and sales made by the Waihi Gold Company were identified, and where possible excluded from the analysis. Any sales involving Waihi Gold Company which have remained in the sample have been so small that their inclusion does not affect the overall results.

Demographic data on populations, population change and the number of occupied dwellings was accessed from Statistics New Zealand for each location, in order to identify the suitability of the comparisons in terms of population size and trends for each town.

Attempts were made to access building construction and building improvements data that could be an indicator of local economic activity but this proved inconclusive. Full records of data on a consistent basis were not readily available.

Events that may have contributed to changes in residential property values other than the Waihi Gold Company activity were identified for all three towns over the 22.5 year period. One event identified was the close of the Phillips (Pye) Television factory in September 1996 at Waihi. That closure preceded the recommencement of mining activity. The major restructuring of the Public Sector from the mid 1980's under Government initiated economic restructuring, generally referred to as 'Rogernomics', was another event that affected many large and small residential communities. The Finance Minister, Roger Douglas, was the prime instigator of economic restructuring in New Zealand under the 1984 Labour lead Government.

Examples of relevant economic restructuring were the closure of the Social Welfare Department at Paeroa and the relocation of the Inland Revenue Department (IRD) from Te Aroha to Hamilton. Other examples at Te Aroha included the progressive closure of the Hauraki Drainage Board and the loss of Power Board New Zealand. At Paeroa the loss in employment was believed to be 50 – 100 persons, with a proportionately lower number at Te Aroha. Although the reduction in employment numbers in each of these two locations was not large their market perception effect would have been reasonably significant. With respect to the Te Aroha, the impact of the IRD closure was reduced as a consequence of employees retaining their homes and commuting to Hamilton.

The most notable economic event over this period was the closure of the Phillips (Pye) Television factory at Waihi, with progressive declining employment numbers from a maximum of 450 in the 1970's to approximately 120 employees by March 1986, many of whom then took voluntary redundancy.

One would have expected this single event at Waihi to indicate a more severe adverse 'public perception' effect on property values than the economic restructuring that affected employment opportunities in Paeroa and Te Aroha. However, this does not show up as a significant factor in the residential property sales data for the three towns between 1980 and 1986.

The population data does, however, indicate that a population rebound occurred at Waihi between the 1986 and 1991 census, almost all of which would be attributable to the Waihi Gold Company activities that directly employed 135 persons from 1987, with that number increased to 227 by 2002 (Wheeler 2001).

The following figures show the changes in Waihi, Paeroa and Te Aroha population and occupied dwellings over time (Statistics New Zealand 2004). There is a clear indication of a jump in population numbers for Waihi between 1986 and 1991. This was almost certainly as a result of the Waihi Gold Company activities.

	<b>1986/91</b>	<b>1991/96</b>	<b>1996/01</b>	<b>1986/01</b>
Waihi Population Change	+12.41%	+3.88%	-7.91%	+7.53%
<i>Paeroa Population Change</i>	+0.75%	+0.89%	-6.20%	-4.66%
<i>Te Aroha Population Change</i>	+2.79%	+0.31%	-6.30%	-3.22%
Waihi Occupied Dwellings Change	+14.97%	+5.85%	-0.28%	+21.36%
Paeroa Occupied Dwellings Change	+6.13%	+4.69%	+1.41%	+12.64%
Te Aroha Occupied Dwellings Change	+5.33%	+5.42%	+2.47%	+13.79%

The three towns are similar in size – with the provisional populations as at the 2001 census date being as follows (slightly varied in final data):

- Waihi: 4,368 people
- Paeroa: 3,810 people
- Te Aroha: 3,612 people

All three towns have experienced a population decline in the five years between the 1996 and 2001 census, this decline being slightly greater in Waihi than the other two towns. However, the figures which reflect the period between 1986 and 2001 indicate that Waihi has grown in population by 7.53% compared with declines in Paeroa (-4.66%) and Te

Aroha (-3.22%). The year 1986 was approximately one year prior to mining activity recommencing in Waihi in 1987 and coinciding with the closure of the Phillips (Pye) Television factory.

The occupied dwelling numbers show a similar pattern, with Waihi experiencing a decline in the number of occupied dwellings (-0.28%) between 1996 and 2001 compared with slight increases in Paeroa and Te Aroha. The trend between 1986 and 2001, shows that Waihi's occupied dwelling numbers have increased 21.36% compared with 12.64% and 13.79% in Paeroa and Te Aroha respectively.

**Table 1** is the collated data of average house and vacant residential land prices in the three towns, analysed in six-monthly periods from the six months to 31 December 1980 up to the six months concluding 30 June 2003.

**TABLE 1**

<b>Waihi, Paeroa and Te Aroha Average Sale Price Comparison</b>													
<b>Single Unit Homes and Vacant Residential Sites</b>													
		Waihi Single Unit Homes		Paeroa Single Unit Homes		Te Aroha Single Unit Homes		Waihi Vacant Residential Sites		Paeroa Vacant Residential Sites		Te Aroha Vacant Residential Sites	
		No. of Sales	Avg Price	No. of Sales	Avg Price	No. of Sales	Avg Price	No. of Sales	Avg Price	No. of Sales	Avg Price	No. of Sales	Avg Price
6 months to	31-Dec-80	8	\$20,553	20	\$32,638	17	\$29,794	3	\$9,333	1	\$5,500	1	\$26,000
6 months to	30-Jun-81	51	\$21,560	45	\$32,509	48	\$28,825	2	\$12,000	6	\$9,700	4	\$8,375
6 months to	31-Dec-81	87	\$26,137	46	\$33,223	53	\$47,170	8	\$10,883	7	\$10,386	5	\$14,400
6 months to	30-Jun-82	65	\$30,356	33	\$40,333	59	\$32,299	12	\$6,817	5	\$12,040	9	\$8,156
6 months to	31-Dec-82	31	\$29,274	27	\$37,235	38	\$30,801	8	\$5,688	1	\$15,000	8	\$9,460
6 months to	30-Jun-83	34	\$29,632	23	\$48,942	35	\$37,433	4	\$7,200	4	\$8,000	5	\$8,760
6 months to	31-Dec-83	41	\$34,043	37	\$41,716	25	\$41,990	8	\$6,928	4	\$40,375	10	\$9,960
6 months to	30-Jun-84	50	\$32,906	31	\$41,823	26	\$44,437	7	\$6,229	9	\$9,861	5	\$6,240
6 months to	31-Dec-84	37	\$36,553	34	\$44,357	28	\$51,275	9	\$8,656	12	\$22,450	11	\$8,440
6 months to	30-Jun-85	65	\$40,866	44	\$51,466	31	\$48,369	22	\$8,341	8	\$13,000	12	\$8,661
6 months to	31-Dec-85	47	\$42,790	36	\$52,379	24	\$54,104	8	\$6,500	5	\$12,060	8	\$11,944
6 months to	30-Jun-86	52	\$42,230	44	\$51,406	22	\$52,591	19	\$10,261	5	\$11,100	6	\$9,042
6 months to	31-Dec-86	53	\$45,922	41	\$52,107	29	\$61,090	8	\$12,813	4	\$15,375	6	\$9,200
6 months to	30-Jun-87	72	\$52,100	38	\$54,650	36	\$59,486	4	\$12,650	0		5	\$16,700
6 months to	31-Dec-87	78	\$56,706	54	\$55,293	35	\$52,557	14	\$13,711	5	\$12,720	4	\$15,975
6 months to	30-Jun-88	59	\$60,445	44	\$57,251	38	\$62,568	13	\$14,385	3	\$10,900	7	\$11,243
6 months to	31-Dec-88	45	\$60,827	49	\$60,694	69	\$65,485	3	\$15,417	5	\$11,780	8	\$14,688
6 months to	30-Jun-89	74	\$66,436	71	\$63,236	51	\$65,786	8	\$16,234	3	\$15,500	8	\$15,550
6 months to	31-Dec-89	37	\$68,176	58	\$63,769	43	\$65,872	17	\$16,029	9	\$11,819	11	\$17,342
6 months to	30-Jun-90	57	\$75,010	40	\$68,644	48	\$72,958	15	\$18,460	4	\$14,875	6	\$11,042
6 months to	31-Dec-90	48	\$70,199	58	\$79,458	36	\$73,597	28	\$16,027	4	\$10,167	13	\$13,463
6 months to	30-Jun-91	41	\$77,634	36	\$68,992	39	\$79,121	8	\$18,125	8	\$23,250	4	\$11,875
6 months to	31-Dec-91	34	\$89,715	33	\$76,667	37	\$81,095	16	\$17,509	3	\$7,833	10	\$18,075
6 months to	30-Jun-92	44	\$79,898	20	\$76,300	16	\$90,950	4	\$16,875	5	\$11,000	3	\$22,000
6 months to	31-Dec-92	32	\$81,960	26	\$67,712	25	\$70,682	8	\$20,078	3	\$16,000	1	\$10,000
6 months to	30-Jun-93	38	\$79,304	29	\$73,105	39	\$82,666	4	\$19,500	3	\$10,667	2	\$34,000
6 months to	31-Dec-93	55	\$77,280	43	\$73,093	40	\$89,125	9	\$33,556	4	\$17,125	5	\$21,730
6 months to	30-Jun-94	47	\$76,583	50	\$78,103	60	\$98,340	1	\$25,000	6	\$15,250	3	\$9,667
6 months to	31-Dec-94	57	\$77,649	43	\$76,465	42	\$95,708	3	\$17,500	2	\$9,344	10	\$24,750
6 months to	30-Jun-95	66	\$79,462	51	\$86,559	38	\$88,671	4	\$22,750	7	\$26,143	4	\$22,712
6 months to	31-Dec-95	58	\$83,845	54	\$86,944	55	\$89,167	5	\$29,300	0		6	\$14,750
6 months to	30-Jun-96	98	\$89,207	58	\$95,018	47	\$90,223	13	\$18,192	1	\$20,000	8	\$16,244
6 months to	31-Dec-96	90	\$92,906	78	\$100,821	40	\$112,950	7	\$27,357	9	\$17,167	6	\$25,417
6 months to	30-Jun-97	70	\$105,341	75	\$101,693	43	\$106,678	18	\$20,944	5	\$19,000	4	\$23,250
6 months to	31-Dec-97	57	\$108,835	74	\$98,672	53	\$98,653	15	\$24,266	8	\$25,375	3	\$14,333
6 months to	30-Jun-98	44	\$106,935	41	\$102,067	47	\$107,591	7	\$29,785	2	\$38,500	3	\$19,500
6 months to	31-Dec-98	48	\$105,489	57	\$99,596	38	\$109,026	7	\$34,000	1	\$11,000	2	\$26,000
6 months to	30-Jun-99	53	\$111,679	46	\$109,510	50	\$117,220	8	\$29,812	3	\$30,000	7	\$25,928
6 months to	31-Dec-99	42	\$111,568	36	\$104,625	56	\$113,814	2	\$33,899	2	\$26,353	3	\$15,000
6 months to	30-Jun-00	37	\$126,718	32	\$100,828	26	\$131,975	3	\$32,833	1	\$30,000	4	\$22,250
6 months to	31-Dec-00	28	\$106,714	15	\$105,233	26	\$117,634	3	\$31,583	0		2	\$23,500
6 months to	30-Jun-01	34	\$97,279	33	\$104,245	42	\$114,630	2	\$34,500	0		2	\$36,000
6 months to	31-Dec-01	29	\$112,922	28	\$112,750	22	\$112,322	5	\$23,400	1	\$42,500	0	
6 months to	30-Jun-02	40	\$115,964	45	\$106,046	44	\$119,400	2	\$38,500	2	\$39,000	0	
6 months to	31-Dec-02	40	\$112,838	40	\$95,790	45	\$125,583	7	\$31,714	4	\$31,750	2	\$26,000
6 months to	30-Jun-03	60	\$116,449	50	\$104,819	77	\$124,959	8	\$36,813	4	\$21,750	1	\$18,000

In examining the prices listed in this table pre 30 June 1987 and post 30 June 1987, there is an unmistakable difference or 'jump' in price at Waihi, relative to price movements that occurred at Paeroa and Te Aroha. For analysis purposes this jump has been considered over a 2 year period from the end of 1986, which preceded recommencement of mining activities up to December 1988, by which time the mine was operational.

**Table 2** illustrates the same information in graphic form, as the 6-monthly increase for average house prices in each of the three towns over a 22.5-year period, highlighting the change of prices pertaining to Waihi in the 1987 – 1988 period.

**Table 2**



The graph is useful as a picture in a number of ways. Primarily, it visually identifies the jump that occurred in house prices at Waihi for the period from 1986, just prior to recommencement of mining activities, up to the end of 1988 by which time the mine was operational.

Later, around 1993 – 1995 there was a tailing off of property value increases for Waihi that may have indicated the onset of the uncertainty that the economic activity enjoyed by Waihi as a result of the mining activities was due to cease in 2000. However, the resource consent application applied for in July 1997 and granted in 1998 to extend the mine appears to have already been anticipated by a rebound in public confidence from 1996.

### Regression Analysis

The relative increase in price from 1980 baseline for each town was analysed using linear regression. It was found that increases in Te Aroha and Waihi were significantly greater

than in Paeroa ( $p < 0.0005$  in each case) and there was a significant additional jump in price in Waihi during the approximately two-year period 1987-8 ( $p = 0.001$ ).

Due to the uncertain price dynamics of that two-year period, those two years were dropped from the analysis. There was no evidence of change in rate of increase after 1988 in Waihi: after the jump, the rate of increase was the same as before 1986. There was no evidence that the rate of increase in Te Aroha or Paeroa differed after 1986 compared to before 1987. The  $R^2$  for the model was 96.8%, meaning the model with three slopes and one jump (for Waihi) accounted for 96.8% of the variation in prices relative to 1980 baselines.

The results that follow for each town can be summarised as follow:

For Paeroa the estimated increase was 5.53% (s.e. 0.09%) per six month over the 22.5 years.

For Te Aroha the estimated increase was 7.35% (s.e. 0.12%).

For Waihi the estimated increase was 9.67% (s.e. 0.56%) with an estimated jump of 50.3% (s.e. 18.3%) over the two year transitional period.

From December 1986 to June 1989, combining the jump and trend, this corresponds to an overall increase of 98.65% of the baseline price: in other words an estimated increase over 2.5 years of \$20285. The actual price change was almost identical at \$20514. (Table 1)

### **Review of Single Unit Dwelling Sales Data**

An 'eye-balling' of the data in Table 1 identifies that a jump did occur at the time mining activities recommenced. Prior to that event the average house price at Waihi was \$45,922, clearly a lower price than the average house price at Paeroa \$52,107 and Te Aroha \$61,090.

At the end of the jump the average house price at Waihi was \$66,436 and at each of Paeroa and Te Aroha, \$63,236 and \$65,766. Relativity has been maintained up to 2003.



Another way of expressing the jump is by the increase in price of the average house at Waihi, that in one year moved upwards by 23.4% or over 2.5 years by 44.7% compared to Paeroa and Te Aroha movements over the 2.5 year period of 21.4% and 7.65% respectively.

Throughout the entire seven-year period prior to 30 June 1987, the average single unit dwelling price in Paeroa and Te Aroha was considerably greater than the average single unit dwelling price in Waihi. Over most of that period, the average Paeroa and Te Aroha prices exceeded the Waihi prices by in excess of 20%, although the gap was narrowing..

In the 16-year period between 30 June 1987 and 30 June 2003, the average single unit dwelling price in Waihi exceeded the average price in Paeroa over most of that period, i.e. in 23 of the 32 six month periods. In the case of Te Aroha, prices consistently exceeded the average Waihi price from 30 June 1980 through to 30 June 1987. The 16-year period from between 30 June 1987 and 30 June 2003 continued to show average single unit dwelling prices in Te Aroha exceeding those in Waihi in all but 9 of the 32 six monthly periods. However, the Waihi house prices have been much closer to the Te Aroha prices since mid-1987 when mining activity commenced, rather than prior to that time.

There is no other event that would explain this movement other than the commencement of mining activities by the Waihi Gold Company. TelferYoung concentrated on the movement over one year but the jump influence is apparent over a 2.0 or 2.5 year period, there being no change in the rate of increase when the 2 years are dropped from the analysis. Regression data is printed below:

#### **Regression Analysis: Increase\_1 versus Sixmonth\_1, TeArohaSlope, ...**

The regression equation is

$$\text{Increase}_1 = -0.0184 + 0.0577 \text{Sixmonth}_1 + 0.0185 \text{TeArohaSlope} + 0.0466 \text{WaihiSlope} - 0.0093 \text{Waihichange} - 0.000093 \text{TeArohachange} - 0.0029 \text{Paeroachange} + 0.463 \text{WaihiJump}$$

Predictor	Coef	SE Coef	T	P
Constant	-0.01841	0.06965	-0.26	0.792
Sixmonth_1	0.057684	0.008663	6.66	0.000
TeArohaSlope	0.018473	0.006820	2.71	0.008
WaihiSlope	0.04662	0.01067	4.37	0.000

Waihichange	-0.00932	0.01332	-0.70	0.485	****
TeArohachange	-0.0000933	0.0001857	-0.50	0.616	
Paeroachange	-0.00288	0.01126	-0.26	0.798	
WaihiJump	0.4631	0.1547	2.99	0.003	

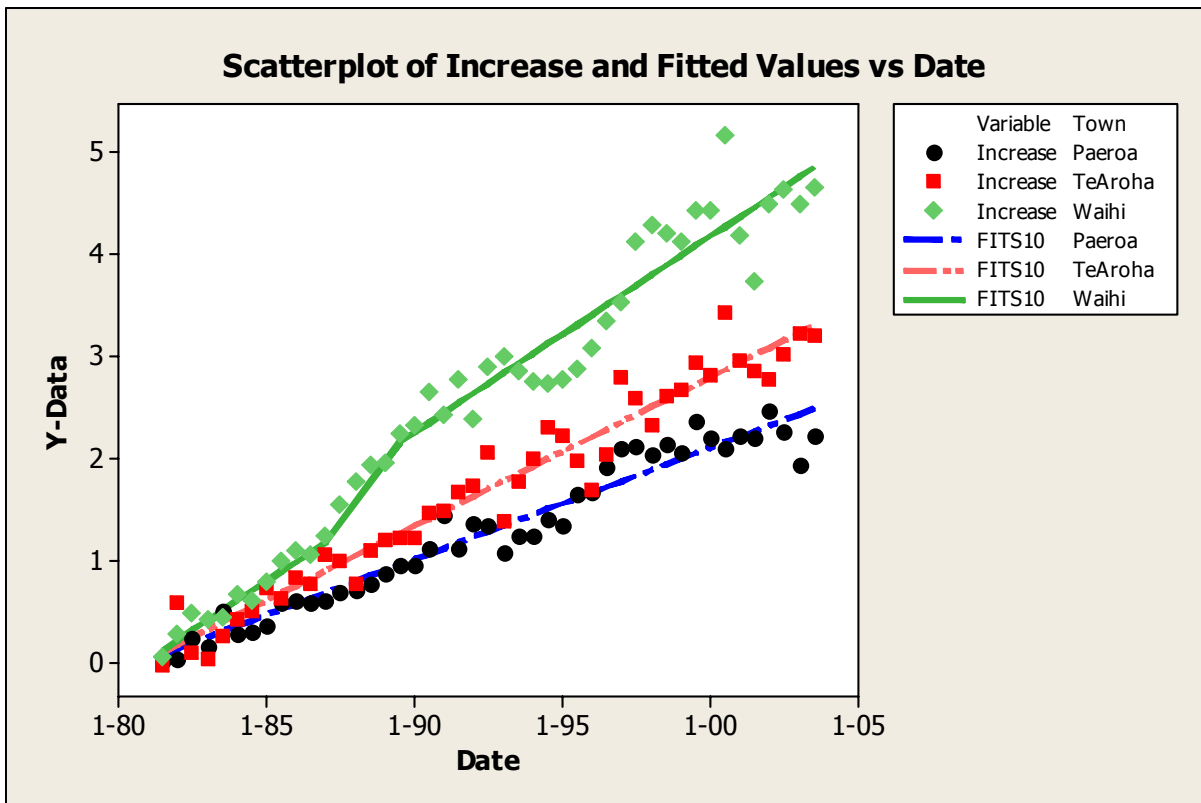
S = 0.230183    R-Sq = 96.8%    R-Sq(adj) = 96.6%

No significant change in slope once the jump is factored in

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	7	195.718	27.960	527.70	0.000
Residual Error	123	6.517	0.053		
Total	130	202.235			

Source	DF	Seq SS
Sixmonth_1	1	144.239
TeArohaSlope	1	1.896
WaihiSlope	1	48.913
Waihichange	1	0.149
TeArohachange	1	0.024
Paeroachange	1	0.022
WaihiJump	1	0.475



### Regression Analysis: Increase versus Sixmonth\_1, WaihiSlope, ...

The regression equation is

$$\text{Increase} = 0.0168 + 0.0548 \text{ Sixmonth}_1 + 0.0415 \text{ WaihiSlope} + 0.0182 \text{ TeArohaSlope} + 0.501 \text{ WaihiJump}$$

131 cases used, 4 cases contain missing values

Predictor	Coef	SE Coef	T	P
Constant	0.01680	0.04062	0.41	0.680
Sixmonth_1	0.054754	0.001857	29.48	0.000
WaihiSlope	0.041459	0.004590	9.03	0.000
TeArohaSlope	0.018173	0.001819	9.99	0.000
WaihiJump	0.5015	0.1430	3.51	0.001

S = 0.227952    R-Sq = 96.8%    R-Sq(adj) = 96.7%

#### Analysis of Variance

Source	DF	SS	MS	F	P
Regression	4	195.688	48.922	941.49	0.000
Residual Error	126	6.547	0.052		
Total	130	202.235			

Source	DF	Seq SS
Sixmonth_1	1	144.239
WaihiSlope	1	45.625
TeArohaSlope	1	5.184
WaihiJump	1	0.639

### Regression Analysis: Increase versus Sixmonth

The regression equation is

$$\text{Increase} = 0.0553 \text{ Sixmonth}$$

Predictor	Coef	SE Coef	T	P
Noconstant				
Sixmonth	0.0553079	0.0009331	59.27	0.000

S = 0.165331

### Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	96.036	96.036	3513.38	0.000
Residual Error	44	1.203	0.027		
Total	45	97.239			

### Results for: te aroha

#### Regression Analysis: Increase versus Sixmonth

The regression equation is  
Increase = 0.0735 Sixmonth

Predictor	Coef	SE Coef	T	P
Noconstant				
Sixmonth	0.073481	0.001210	60.73	0.000

S = 0.214387

### Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	169.52	169.52	3688.22	0.000
Residual Error	44	2.02	0.05		
Total	45	171.54			

#### Regression Analysis: Increase\_1 versus Sixmonth\_1, WaihiJump

The regression equation is  
Increase\_1 = 0.0520 + 0.0952 Sixmonth\_1 + 0.498 WaihiJump

41 cases used, 4 cases contain missing values

Predictor	Coef	SE Coef	T	P
Constant	0.05203	0.09454	0.55	0.585
Sixmonth_1	0.095188	0.006326	15.05	0.000
WaihiJump	0.4980	0.1851	2.69	0.011

S = 0.294902    R-Sq = 96.4%    R-Sq(adj) = 96.2%

#### Analysis of Variance

Source	DF	SS	MS	F	P
Regression	2	87.672	43.836	504.05	0.000
Residual Error	38	3.305	0.087		
Total	40	90.977			

Source	DF	Seq SS
Sixmonth_1	1	87.043
WaihiJump	1	0.629

### **Review of Residential Section Sales Data**

A similar trend is shown when examining the prices paid for vacant sections in Paeroa, Waihi and Te Aroha. During the period from June 1980 through to June 1987 Paeroa section prices exceeded Waihi section prices. However, the trend changed dramatically thereafter when residential section prices in Waihi exceeded average prices in Paeroa in almost all periods. A similar pattern emerges when comparing the residential sections data for Waihi and Te Aroha.

Repeat sales analysis analysis, was undertaken by TelferYoung over a short time frame between Waihi West and Waihi East, to determine if the mine, closer to Waihi East, was adversely affecting price compared to homes further removed from the mine. Improvements to homes based on data obtained from the Hauraki District Council through building consent approvals were considered to ensure data comparability between sale dates. Research on this data has not been undertaken, but it is worthy of note that TelferYoung concluded that in their opinion the data supported the view there was no overall negative impact of the mine on properties located geographically closer to the location of mining operations. Negative effects were exceeded by positive effects. This would be the subject of a further study.

### **SUMMARY AND CONCLUSIONS**

Waihi Gold Company activity commenced on 16 July 1987, the date of the Mining Licence approval, and mining operations commenced in 1988, with a build up of activity over the period 1987 – 1988.

The residential property values at Waihi showed a jump between December 1986 and June 1989. Linear regression confirmed that the rate of increase for all three towns remained consistent when the sales increases for 2 years of market activity was removed from the Waihi data.

A consideration of average price movements for residential property in Table 1 by ‘eye-balling’ the increase in property value movements, numerically and intuitively indicated that this would be the logical result.

A similar and potentially more dramatic pattern of residential site vacant land prices could be analysed, utilising the data in Table 1. This was not undertaken.

The null hypothesis  $H_0$  was:

***Environmental stigma has occurred at Waihi as a result of gold mining activities as measured by an adverse effect on residential property values.***

There is no support for the null hypothesis. The alternative hypothesis  $H_a$  is:

***The mining activity which recommenced at Waihi in 1987 has had a positive impact on residential property values***

Alternatively, in line with the definition proposed:

***‘Environmental valenhance’ has occurred at Waihi as a result of gold mining activities as measured by a positive effect on residential property values.***

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This paper could not have been prepared to an acceptable standard without the assistance of TelferYoung and in particular R Peter Young, who made their archive files available for research purposes. The archived data dates from 1980 and includes sales records in hard and electronic copy on improved and vacant residential properties in the three towns over a 22.5 years period, applications for resource consents, approval reports on environmental effects by other experts, submissions by objectors, decisions and a general wealth of data on the Martha Mine/Waihi Gold Company, accumulated over a period of 18 years. .

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