THE VANCOUVER ISLAND MINERAL POTENTIAL PROJECT (92B, C, E, F, G, K, L AND 102I)

By Nick W. D. Massey

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INTRODUCTION

The Vancouver Island project was the first of the British Columbia mineral potential projects, being launched in June 1992. It was the test bed on which the methodology described by Kilby (1995, this volume) was developed.

The project area included Vancouver Island, the Gulf Islands and those parts of the mainland which are underlain by clearly identifiable Wrangellian stratigraphy. This area includes Texada and Lasqueti islands although they were not considered part of the Commission on Resorces and Environment's (CORE) Vancouver Island planning process. The area has a long history of mineral exploration and exploitation dating from the discovery of coal near Fort Rupert in 1848. Over 1300 mineral occurences are recorded in MINFILE and more than 1900 assessment reports have been filed since 1947. At present, four mines are operating on Vancouver Island - Island Copper (Cu,Ag, Mo, Au), Myra Falls (Cu, Zn, Ag, Au, Pb), Benson Lake (limestone) and Quinsam (coal) and three limestone quarries are operating on Texada Island - Blubber Bay, Gillies Bay and Imperial.

PHASE 1

The geology of the Island was compiled at 1:100 000-scale during the period from June to October 1992. Data were derived from a variety of sources including published maps and reports, theses and assessment reports (see Data Sources, below). The line work was digitized into the GIS and all polygons tagged as compilation progressed. The complete digital data were released in 1994 (Massey *et al.*, 1994).

The project area has been divided into 59 tracts (Figure 1). The tracts reflect significant differences in lithologies, structure and geological history, particularly where these are important to metallogeny, for example the Leech River Complex, the Sicker Group uplift areas and the Nanaimo Group. Where necessary, large lithologically determined tracts were subdivided, in order to have more convenient and more equal sized tracts. Tract definition made use of geological features, such as major faults or contacts, where possible. The tracts vary in size from 2138 to 215 677 hectares, averaging 58 368 hectares.

The number of mineral occurrences, the value of known resources in the ground, the value of exploration expenditures (as recorded or allowed in assessment reports) and the value of past production were compiled for each tract (Table 1, Figure 2). Tracts were then ranked and aggregated by area into three groups of highest, medium and lowest mineral potential, each category comprising approximately one third of the total project area (Figure 3). The results of this analysis were presented for use of the Vancouver Island CORE process and also displayed at Cordilleran Roundup 1993.

The highest ranked tracts include those underlain by or containing significant Sicker Group (*e.g.* the Cowichan and Buttle Lake uplifts), Tertiary intrusions (Zeballos, Mount Washington), Leech River Complex, Upper Triassic limestones (Texada and Quadra islands, Alice Lake) or Bonanza Group volcanics (Pemberton Hills). The lowest ranked areas occur in the east-central part of the Island and along the west coast fringe. They include the areas underlain by the Nanaimo Group which have significant coal and coalbed methane potential not considered in this analysis, but included in a separate energy study.

PHASE 2

The Phase 2 analysis was initiated with a workshop for potential expert estimators held on March 8, 1993 in Victoria. Attendees were drawn from industry, Ministry of Energy, Mines and Petroleum Resources and the Geological Survey of Canada. As a result, seventeen experts made 1127 separate estimations. The resultant value of estimated resources was used to re-rank the tracts (Table 1, Figure 4) and regroup them into the highest, medium and lowest categories (Figure 5).

As in phase 1, the highest ranked tracts include those containing Sicker Group, Tertiary intrusions, Leech River Complex, Upper Triassic limestones and Bonanza Group volcanics. Lowest ranked tracts include those dominated by Nanaimo Group sediments, Karmutsen Formation basalts, or Tertiary rocks along the western edge of the Island.

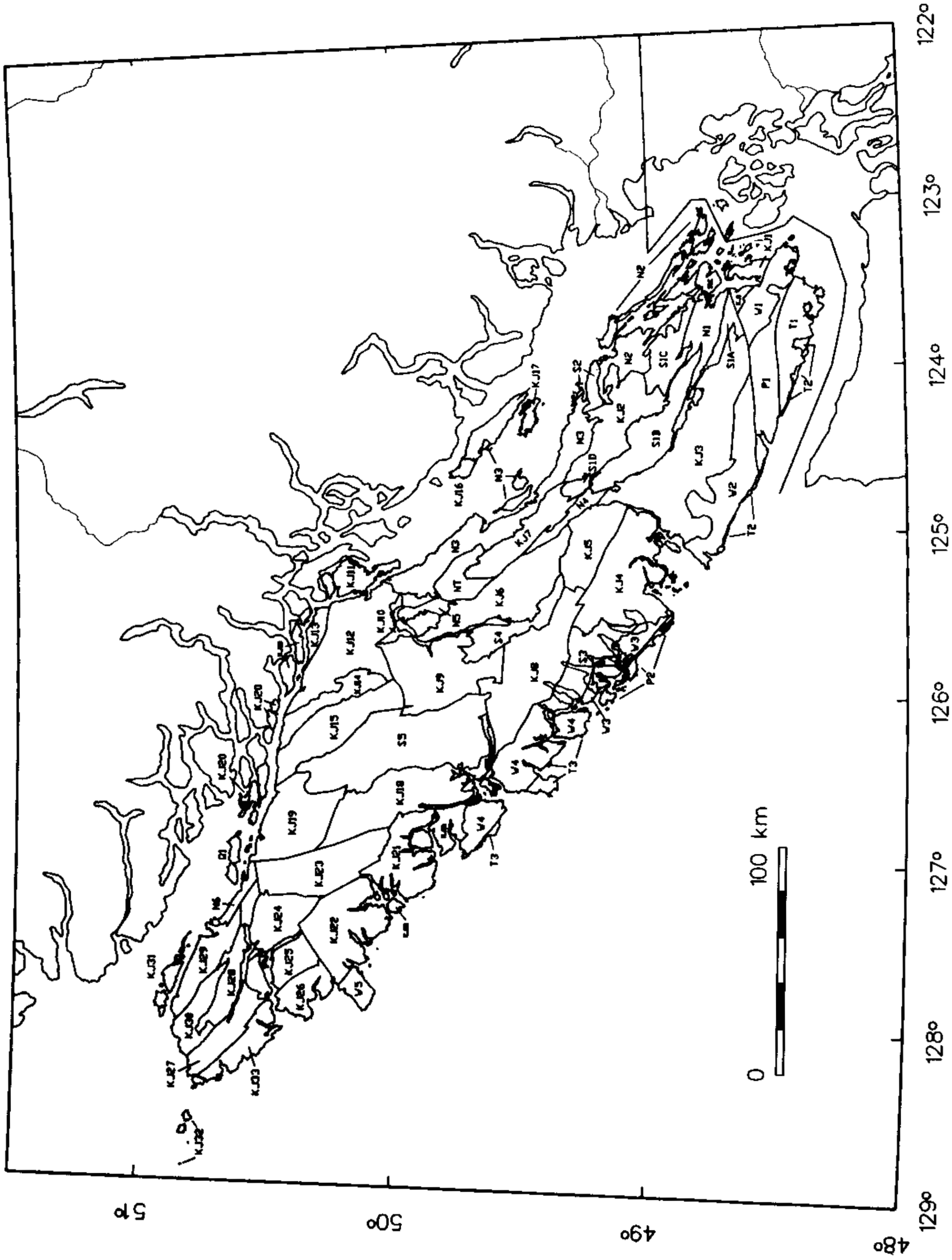

Figure 1. Mineral land assessment tracts for the Vancouver Island project.

TABLE 1: SUMMARY OF DATA FOR VANCOUVER ISLAND TRACTS

Tract Code*	Tract Name	Area ha	Number of MINFILE Occurrences	Value of Known Mineral Inventory $ (1986)	Exploration Expenditures $ (1986)	Value of Past Production $ (1986)	Phase 1 Ranking	Estimated Value of Future Resources $ (1986)/ha	Phase 2 Ranking
KJ28	Pemberton Hills	46,200	60	6,657,910,620	9,631,090	2,081,787,998	1	252,[illegible]85	1
KJ16	North Texada	5,602	70	54,933,062	1,732,992	113,567,236	2	154,[illegible]90	2
S3	Bedwell Sound	55,178	36	30,405,508	471,768	632,186	16	152,[illegible]59	3
KJ26	Le Mare Lake	34,020	11	-	231,368	-	36	111,[illegible]78	4
S1D	Summit	8,109	8	-	61,957	-	30	97,[illegible]56	5
S1A	Koksilah	17,411	19	-	121,936	61,422	20	81,[illegible]91	6
S4	Buttle Lake	46,308	24	2,126,554,822	1,103,477	1,132,377,838	3	70,[illegible]73	7
W3	Clayoquot	32,233	15	1,130,122,000	403,436	-	9	69,[illegible]19	8
KJ25	Klootchlimmis Inlet	41,582	19	11,666,192	930,019	8,741,835	8	41,[illegible]24	9
S1C	Saltspring-Chipman	52,644	43	138,918,904	3,936,089	40,073,253	5	40,[illegible]43	10
KJ21	Esperanza Inlet	99,850	49	156,784,342	420,995	111,351,289	11	35,[illegible]26	11
NT	Mount Washington	31,671	16	52,430,107	2,897,464	9,748,543	4	32,[illegible]40	12
KJ17	Texada-Lasqueti	30,385	37	-	708,592	280,608	18	30,[illegible]52	13
S1B	North Cowichan	77,124	86	29,270,629	6,185,907	2,138,836	6	26,[illegible]66	14
W4	Nootka-Flores	119,892	34	68,948,530	1,069,007	2,669,098	15	25,[illegible]06	15
S5	Schoen-Muchalat	197,550	10	-	428,819	-	46	22,[illegible]08	16
KJ3	Nitinat River	215,677	97	-	2,259,318	13,217,224	19	22,[illegible]54	17
KJ14	White River	38,895	4	5,440,033	50,437	-	50	19,[illegible]33	18
P1	Leech River	64,006	27	5,853,231	1,945,267	334,868	13	17,[illegible]57	19
KJ24	Alice Lake	52,545	40	149,154,000	413,696	126,317,956	7	16,[illegible]65	20
KJ33	Winter Harbour - Cape Scott	36,670	1	-	12,333	-	54	15,[illegible]89	21
KJ22	Ououkinsh Inlet	97,963	29	-	1,159,749	-	32	13,[illegible]92	22
KJ23	Karmutzen Range	98,761	36	-	580,252	3,136,738	23	13,[illegible]05	23
KJ10	Upper Quinsam Lake	17,668	10	-	82,002	4,038	22	11,[illegible]37	24
N2	Nanaimo	78,371	48	-	167,132	-	37	9,[illegible]90	25
KJ11	Quadra Island	26,984	67	9,876,094	326,898	692,996	10	9,[illegible]30	26
N4	Alberni Valley	20,864	5	-	60,122	-	43	8,[illegible]18	27
W1	Victoria-Shawnigan	46,079	16	-	17,505	-	47	8,[illegible]59	28
KJ4	*Kennedy Lake*	*131,617*	*104*	*50,419,732*	*1,655,057*	681,424	14	8,[illegible]31	29
KJ7	Beaufort Range	57,764	8	-	67,435	-	48	7,[illegible]88	30
KJ19	Bonanza Lake	93,460	31	14,999,388	953,740	218,570	17	7,[illegible]20	31
KJ1	Saanich	16,609	6	-	-	-	61	7,[illegible]08	32
KJ30	Nahwitti Lake	35,827	18	-	756,516	-	25	6,[illegible]54	33
KJ5	Sproat Lake	66,052	29	-	1,443,637	-	24	6,481	34
S2	Nanoose Arch	12,002	7	-	85,579	-	31	6,106	35
KJ20	North Johnson Strait	16,295	10	-	29,832	-	40	6,[illegible]35	36
W2	Bamfield-Renfrew	95,627	23	45,981,324	249,201	-	42	5,[illegible]32	37
KJ27	San Josef River	43,224	9	-	784,337	-	34	5,134	38
KJ32	Scott Islands	2,138	0	-	-	-	59	4,732	39
KJ8	Moyeha River	137,044	36	-	452,996	3,242,193	28	3,[illegible]93	40
KJ9	North Strathcona	118,352	9	-	210,040	26,331	39	3,[illegible]61	41
KJ15	Adam River	85,176	12	-	550,340	-	38	3,735	42
W5	Brooks Peninsula	15,514	1	-	-	-	55	3,690	43
KJ18	Woss Lake	113,859	29	2,059,184	444,917	8,413,906	27	3,672	44
N5	Quinsam	12,858	2	-	22,260	-	44	3,663	45
N3	Comox	121,326	9	-	5,835	-	53	3,478	46
KJ2	Nanaimo Lakes	85,732	29	-	1,466,324	8,949	21	3,[illegible]97	47
KJ6	East Strathcona	111,440	12	-	214,791	-	45	3,[illegible]34	48
P2	Pacific Rim	11,470	5	-	27,874	311,228	29	3,1[illegible]3	49
KJ29	Georgia Lake	46,469	14	-	446,064	-	35	2,072	50
N1	Duncan	48,741	9	-	1,324,981	-	26	1,[illegible]58	51
T1	Sooke-Renfrew	59,489	28	37,417,380	337,038	27,810,391	12	1,2[illegible]2	52
KJ13	Rock Bay	29,081	3	-	10,803	-	52	1,138	53
KJ12	Salmon River	133,974	14	-	126,992	1,859	41	[illegible]12	54
KJ31	Nigei	11,222	0	-	-	-	58	[illegible]31	55
T3	Hesquiat	10,272	1	-	-	-	56	449	56
N6	Suquash	11,992	2	-	10,155	-	49	432	57
T2	Juan de Fuca Strait	9,254	1	-	119,644	-	33	210	58
Q1	Malcolm Island	8,665	0	-	-	-	57	-	59

* letters in tract code designate dominant geological unit as follows:

Q: Quaternary
N: Nanaimo Group
P: Pacific Rim Terrane
W: West Coast Complex
T: Tertiary Carmanagh Group or Matchosin Complex
KJ: Vancouver and Bonanza Groups, Island Plutonic Suite
S: Sicker and Buttle Lake Groups

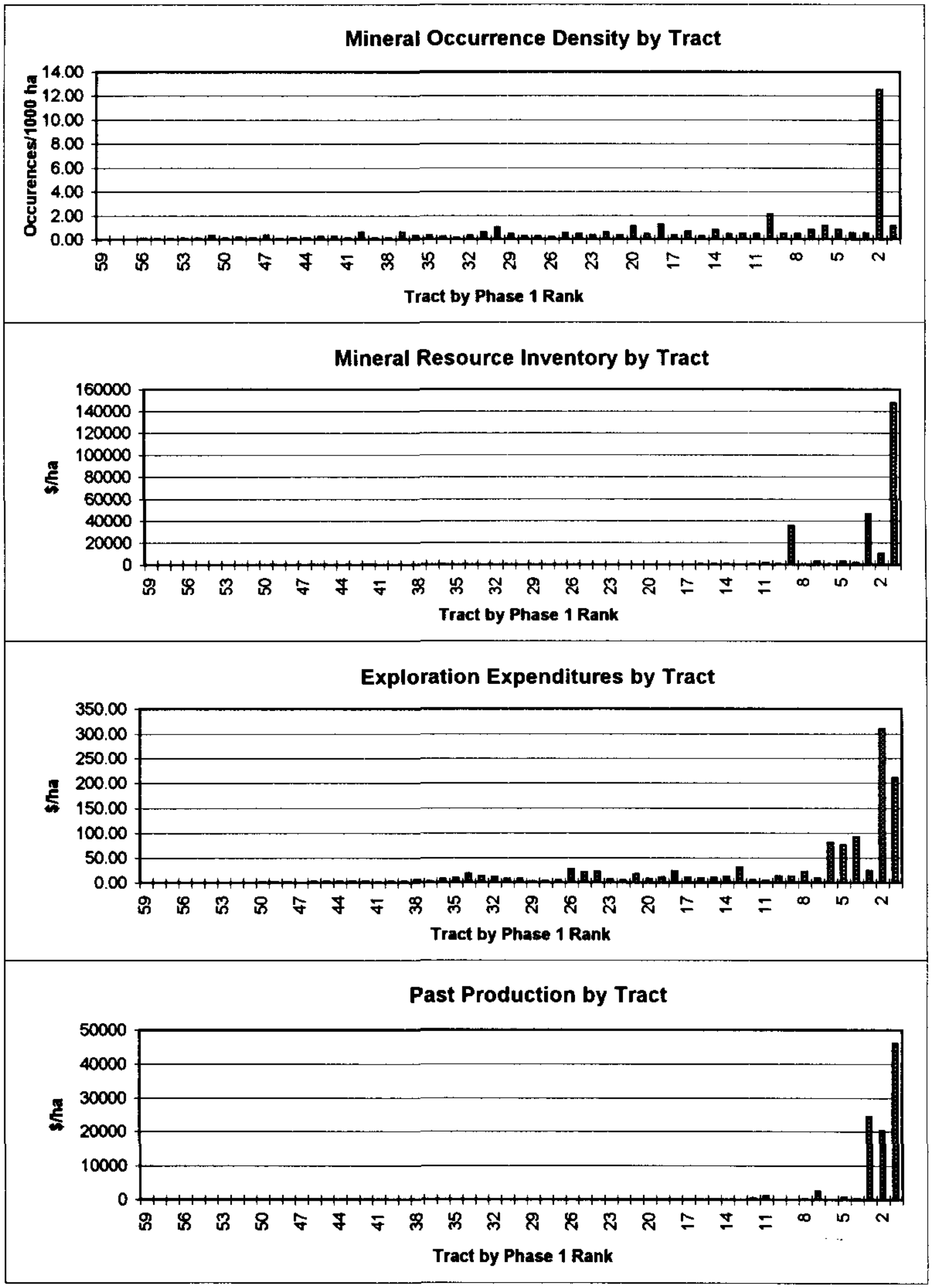

Figure 2. Ranges of data used in the phase 1 evaluation. The tracts are ordered from lowest (59) to highest (1), see Table 1.

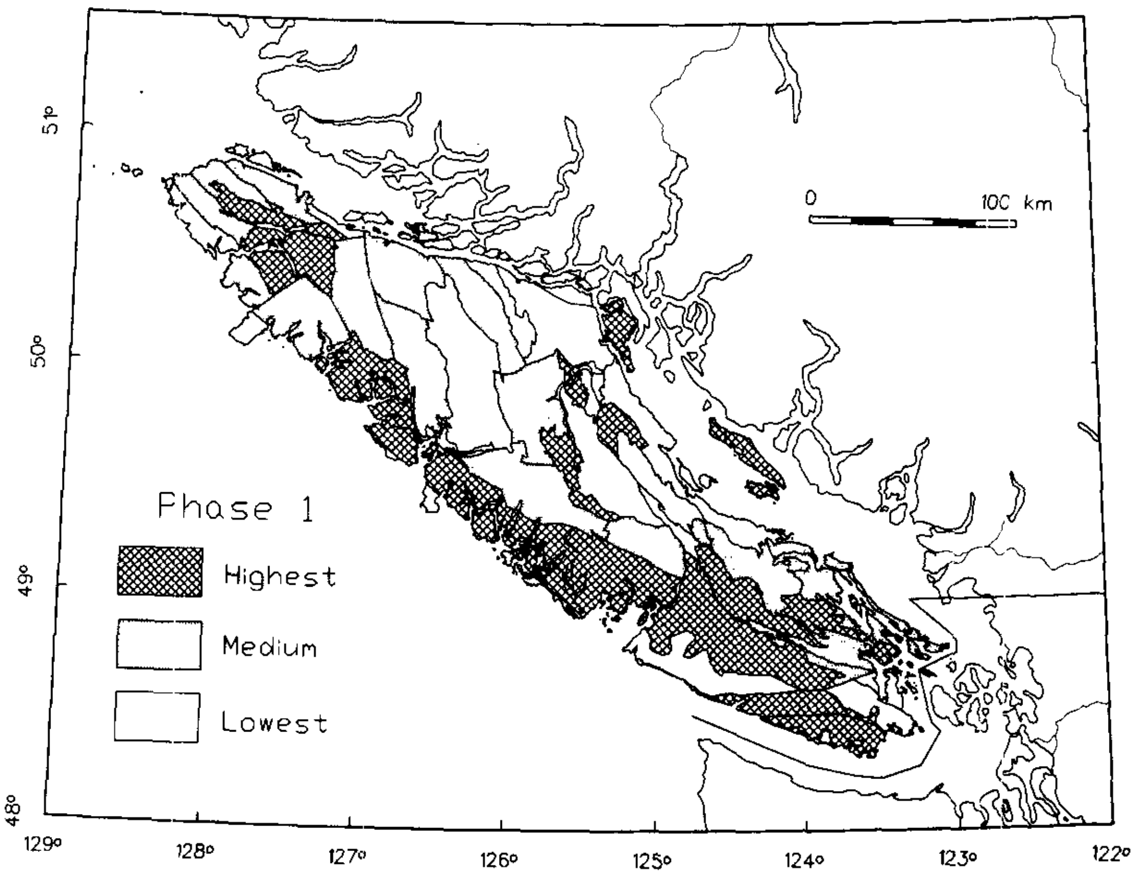

Figure 3. Distribution of phase 1 mineral potential categories. lowest tracts include those ranked 40 - 59; medium 20 - 39; highest 1 - 19

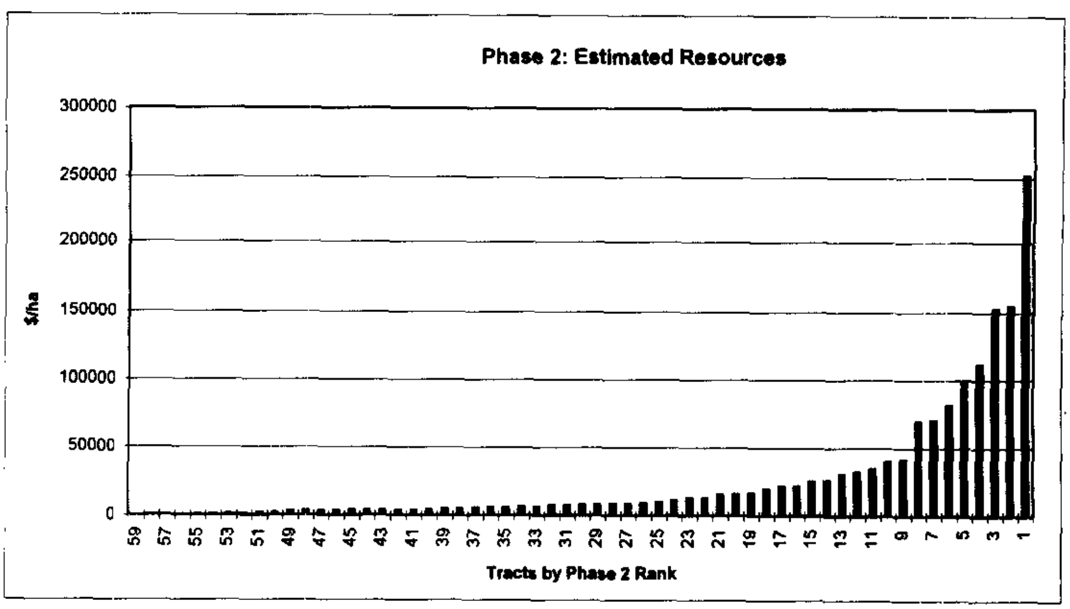

Figure 4. Range of phase 2 values ($/ha) for tracts in the Vancouver Island project area.

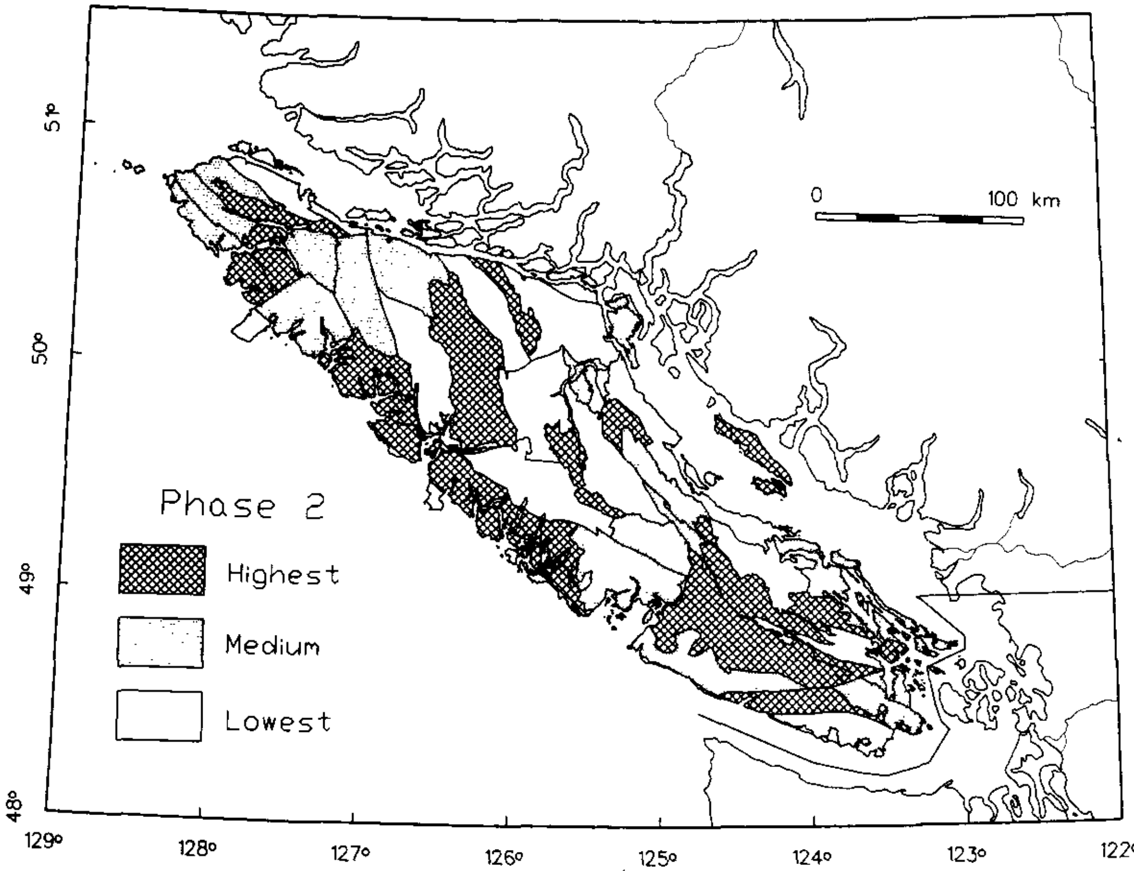

Figure 5. Distribution of phase 2 mineral potential categories. lowest tracts include those ranked 40 - 59; medium 20 - 39; highest 1 - 19.

COMPARISON OF PHASE 1 AND PHASE 2 RESULTS.

The addition of the estimated undiscovered resouces in phase 2, coupled with the consideration of a larger list of commodities than phase 1, may be expected to have an effect on the results of the mineral potential analysis. Despite the different methods used, the two phases of the study both express their findings as a relative ranking of the 59 tracts. The results of the two phases can thus be directly compared by looking at the relative rankings for individual tracts to see if any of them show significant changes.

Comparison of Figures 3 and 5 show many tracts fall in the same categories. However, several tracts have changed; the most startling being the Sooke-Renfrew area of southern Vancouver Island which dropped from highest to lowest categories, and the Schoen-Muchalat area which moved up from lowest to highest categories. It is easier, however, to compare the results of the two phases by plotting a histogram of the changes in relative rankings (Figure 6). Changes in relative ranking are generally not large and do not have a major impact on the final outcome. However, some tracts have moved more than 20 places in the ranked list, some upwards, some downwards.

Significantly, those tracts that have a large decrease in relative ranking occur in southern Vancouver Island. Here access and past exploration have been good and these tracts have good historical databases, consequently scoring high in phase 1. However, they are considered by the experts to have a poor potential for finding new resources and score much lower in the phase 2

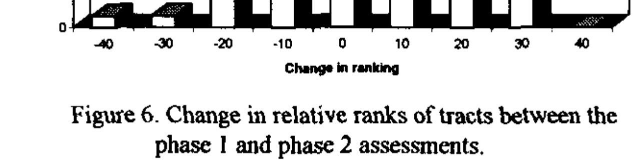

Figure 6. Change in relative ranks of tracts between the phase 1 and phase 2 assessments.

assessment. In contrast, areas in Northern Vancouver Island have poorer accessibility and have been less well explored in the past. However, they are underlain by geology that is very favourable to the discovery of more resources in the future, or contain resources such as magnetite skarns, excluded from the phase 1 process. These tracts thus ranked much higher in phase 2.

LAND USE RECOMMENDATIONS AND MINERAL POTENTIAL

The establishment of the Commission on Resources and Environment provided the major stimulus to the Branch's re-evaluation of the regional mineral potential of British Columbia. As such, the Commission's initial planning areas and timetable were the major influence on choice of areas of study and scheduling of geological compilation and data analysis.

As they were completed, the results of the mineral potential analyses were presented to the government Technical Working Group supporting the CORE process. They were incorporated into a GIS, along with other biophysical and cultural data sets. The final GIS model consisted of 26 groups of data divided into 114 layers. The mineral potential data formed one of these layers, with the energy potential and mineral tenure as separate, complementary layers. The attribute data accompanying the tract polygons comprises not only the tract rankings from both phases but all the supporting data behind those rankings, for example, the numbers of mineral occurrences recorded in the MINFILE database, exploration expenditures, etc.

After assembling the data, the Technical Working Group produced hard copy maps at 1:250 000-scale for each of the biophysical themes. Copies of these maps were then distributed to each sector at the Vancouver Island CORE Table for their use during deliberations. Separate maps were produced for minerals, energy and mineral tenure. Computers, loaded with the GIS data model, were also available during Table meetings to allow for interactive viewing and comparison of datasets.

It is almost impossible to evaluate how effective the mineral potential data were during the CORE Table deliberations due to the complex sociopolitical nature of that process and its failure to reach a concensus by the deadline date set by CORE. Anecdotal evidence confirms that the data were presented to all sectors, were available and consulted during meetings, and used in the evaluation of the various proposed land-use scenarios. It is easier, and maybe more useful, to evaluate the government's final land-use plan, based on the recommendations of the Commissioner, and their effect on mineral exploitation on Vancouver Island.

Table 2 summarizes the recommended land use subdivisions and the aggregate areas and proportions of each designation which fall in tracts of high, medium or low mineral potential from the phase 2 analysis. The areas are based on the preliminary recommended boundaries. These boundaries are presently being reviewed and a few will be the subject of major revisions. Comparing these spectra of mineral potential in the various categories suggests that the land available to exploration and mining (total multi-resource and low intensity areas) contains proportionally more high-value ground, and less low-value ground, than the lands to be protected.

However, this is a fairly simplistic analysis and looking at the data in more detail does point out some areas of possible concern. The proposed protected areas have significantly more medium-value ground compared to the rest of Vancouver Island. Also the regionally significant lands, which will have stricter review of work proposals, are dominated by high and medium-value

TABLE 2: MINERAL POTENTIAL OF RECOMMENDED LAND USE CATEGORIES

	HIGH		MEDIUM		LOW		TOTAL	
	ha	%	ha	%	ha	%	ha	%
Existing Protected Areas	75680	22.33	107843	31.82	155362	45.85	338885	10.31
Proposed Protected Areas	20069	22.29	53378	59.29	16583	18.42	90030	2.74
Multi-resource Lands	1002710	41.99	710029	29.74	675062	28.27	2387801	72.62
Low Intensity Areas	97483	36.16	132048	48.99	40035	14.85	269566	8.20
Cultivation	4929	5.11	26823	27.82	64653	67.06	96405	2.93
Settlement	10276	9.74	36728	34.81	58516	55.45	105520	3.21
Total Vancouver Island	1211147	36.83	1066849	32.44	1010211	30.72	3288207	100.00
Total Multi-resource + LIAs	1100193	41.40	842077	31.69	715097	26.91	2657367	80.82
Total Protected	95749	22.32	161221	37.59	171945	40.09	428915	13.04

ground.

To a large extent this reflects the somewhat arbitrary nature of the subdivision of the high-medium-low lands and the nonlinear range of values for the tracts (Figure 4). The arithmetic average mineral value of land for Vancouver Island is approximately $20 000 per hectare. However, tracts with values greater than this make up only 31.5% of the Island and would all be ranked as high potential. Thus all the medium and low-potential land has values less than the arithmetic average. The median value, that is the value exceeded by tracts that make up 50% of the area of Vancouver Island, is lower at $8000 per hectare. A significant jump in value occurs at about $50 000 per hectare, but tracts exceeding this value constitute only 7% of Vancouver Island. The values of $8000, $20 000 and $50 000 per hectare may be better benchmarks to use in evaluating the impact of land-use decisions.

Perhaps a more informative way to review the land use decisions is to consider the range of values for the various parcels of land designated as protected or low intensity and how they compare to each other and to the full range of values for the tracts. In order to carry this out, the phase 2 value has been calculated for each area designated as presently protected (EPA), proposed protected (CPA) or low intensity (LIA). Where a designated area is wholly contained within a single tract, it assumed the same ranking as that tract. Where it straddles more than one tract, an area calculation was made for the proportions of the study area within each tract, and those values used as weightings to the tract rankings to determine a fractional rank. These values were then added to determine a total rank for the area. Only the on-land portions of the areas were included as the mineral potential of marine areas has not yet been determined. Figures 7, 8 and 9 display the phase 2 values and areas of the existing protected areas, proposed protected areas and low intensity areas, respectively. The areas were also aggregated by tract and compared to the phase 2 tract values in Figures 10 to 12.

The existing protected lands show a range of values from $1000 to $150 000 per hectare (Figure 7). However, the areas of the higher value parks are small, a total of 6133.9 hectares with values over $50 000 per hectare. Strathcona Park with a weighted average value of $15 298 per hectare accounts for 71.4% of the total existing protected area. The distribution by tract (Figure 10) shows most of the land to be in the lowest value tracts, but a significant area in the higher tracts (21.9% in tracts over $20 000 per hectare, 13.6% over $50 000 per hectare). Most of this, however, is in tract S4, Buttle Lake, the most significant part of which is not actually alienated, falling within the Westmin Myra Falls mining lease.

The proposed protected lands (Figure 8) range in value from $900 to $41 500 per hectare, comparable to the existing protected areas. None have weighted values above $50 000 per hectare, and seven parcels, comprising 21.4% of the total CPA, have values over $20 000 per hectare. The largest of these parcels will warrant more

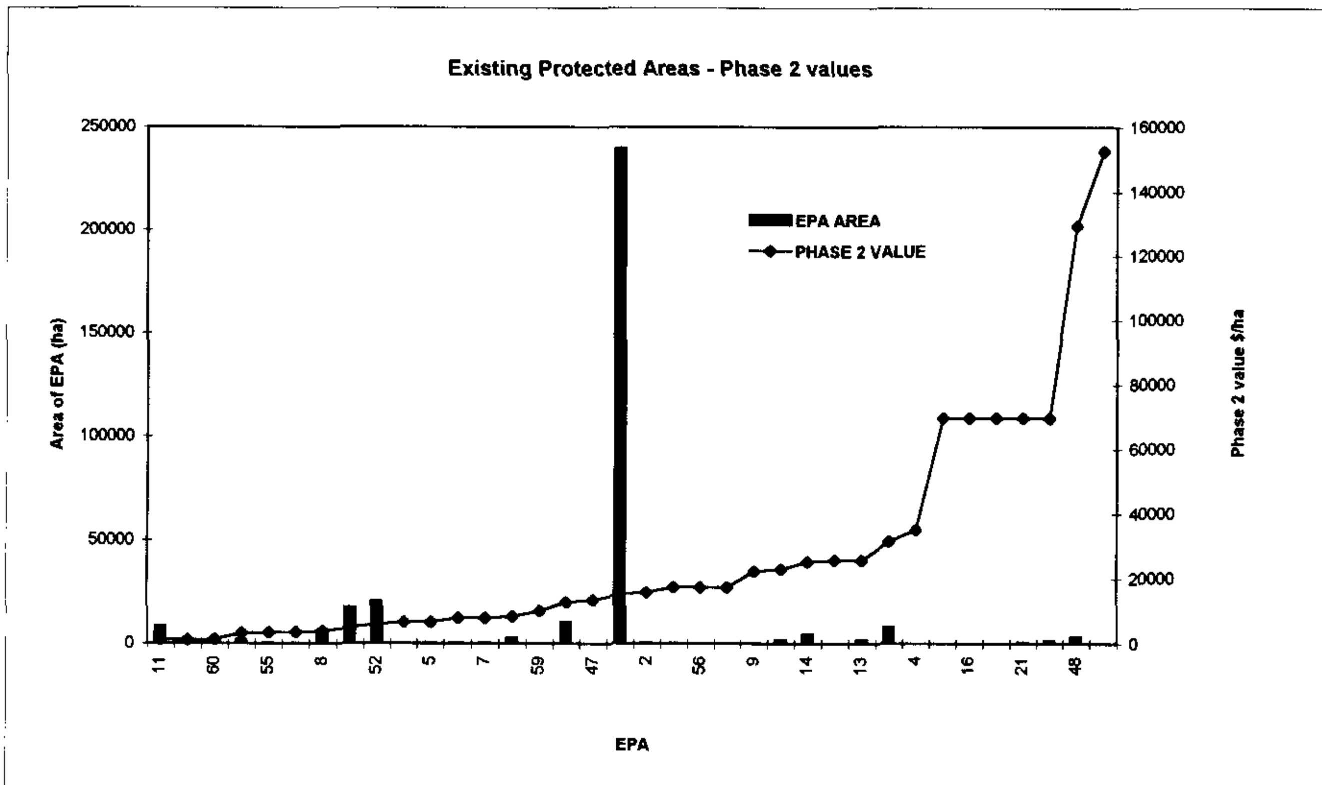

Figure 7. Phase 2 values for existing protected areas, Vancouver Island CORE region.

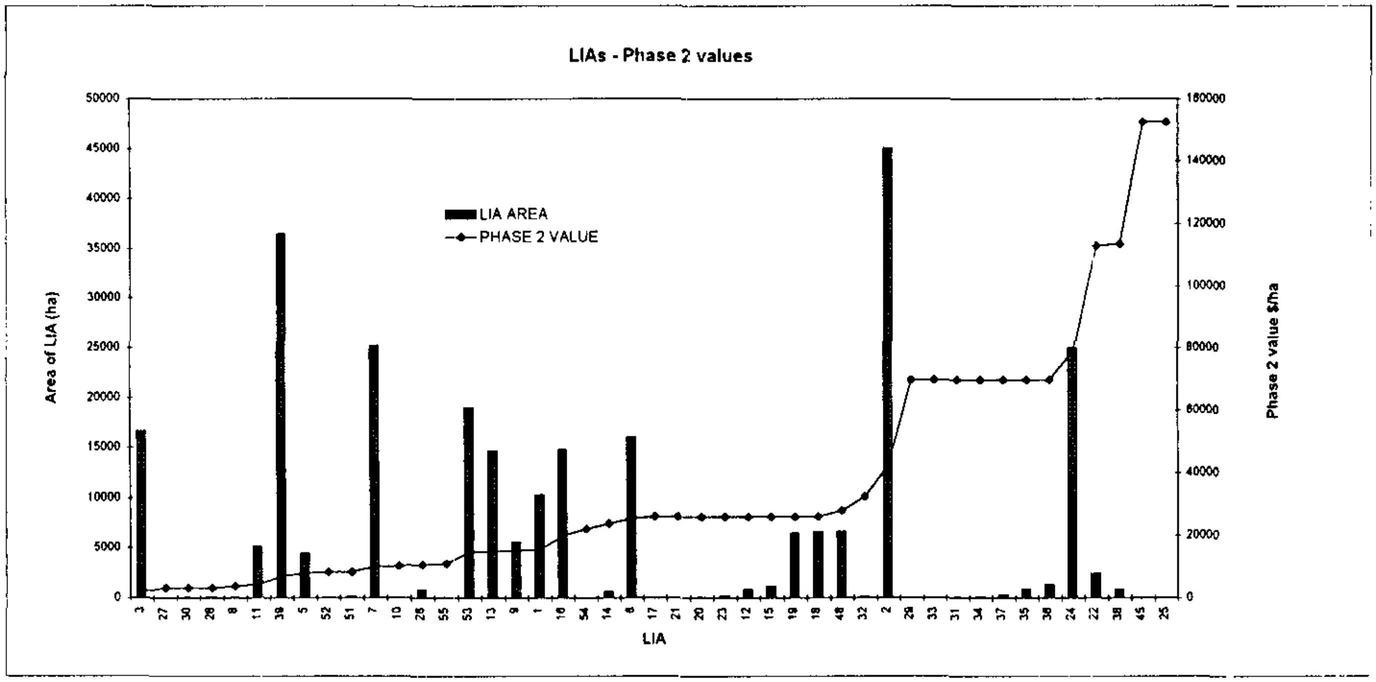

Figure 8. Phase 2 values for proposed protected areas, Vancouver Island CORE region.

detailed analysis to determine the local impact of alienation and possible boundary changes. The distribution by tract (Figure 11) shows most of the proposed protected land to be in tracts with values below the median of $8000 per hectare.

The low intensity areas (Figure 9) are very variable in size (<2 to 45 000 hectares) and weighted value ($2000 - $150 000 per hectare). The largest of these parcels are directly comparable in size to some tracts and warrant more detailed evaluation than given here. There is more high-value land in this category than in the protected lands, although it is concentrated in a few very large parcels. The distribution by tract (Figure 12) shows most (68%) of the LIA to be in tracts with values above the median of $8000 per hectare, 35% above $20 000 and 13% above $50 000. Although these percentages are higher than those for Vancouver Island as a whole, they are not significantly different to the range of values in the 80% of the island available to multi-resource use (the population from which the LIAs are drawn) suggesting that the designation of LIAs has been essentially mineral neutral.

Protected and alienated lands on Vancouver Island are disproportionately drawn from areas considered to be of lower value. The designation of LIAs, however, appears to have been mineral neutral, being based on other values. On the sub-regional scale, the designation and boundaries of land use areas are undergoing detailed review by government agencies. The above information is being considered in that review.

DATA SOURCES USED IN GEOLOGICAL COMPILATION

This list contains all published and unpublished, data used in the compilation of the geology of Vancouver Island. Numerous assessment reports were also consulted providing data supporting or enhancing the listed sources. Aeromagnetic maps at 1:50 000 scale are available for the whole project area and were utilized, though they are not included in the listing.

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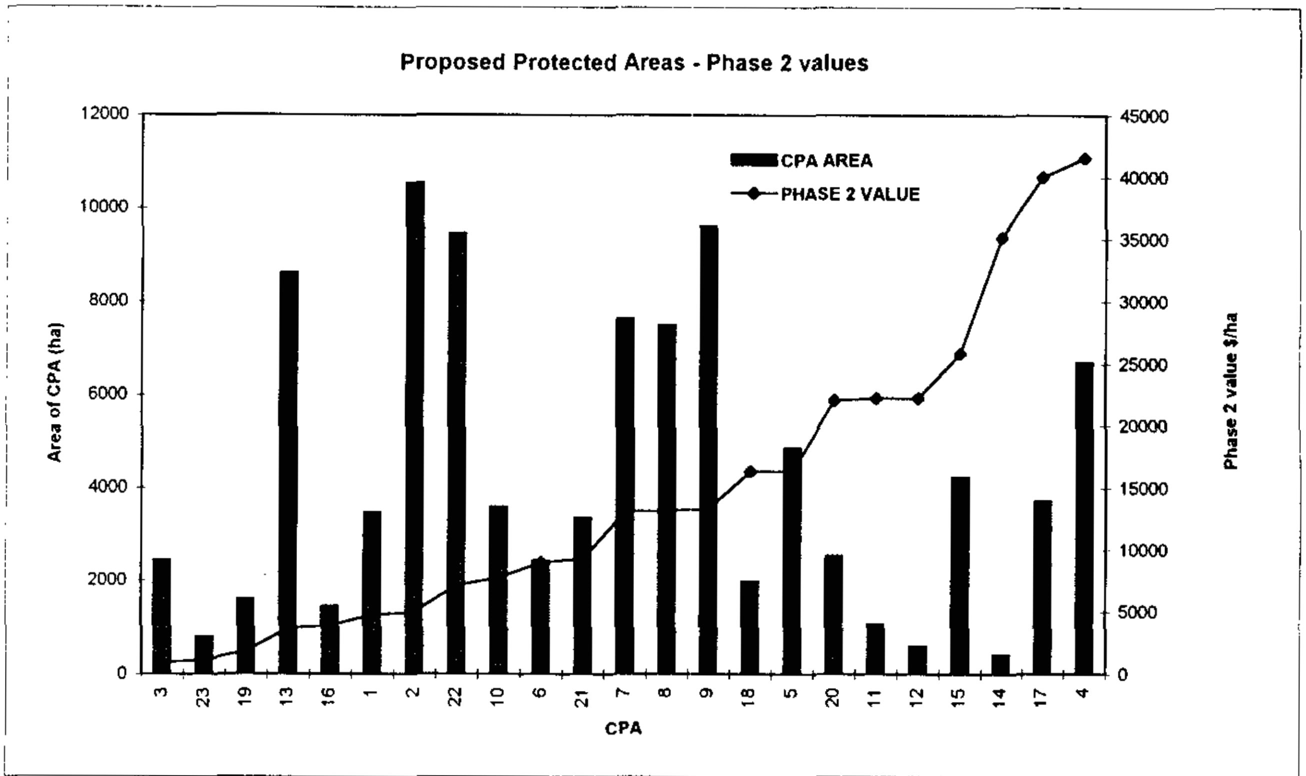

Figure 9. Phase 2 values for low intensity areas, Vancouver Island CORE region.

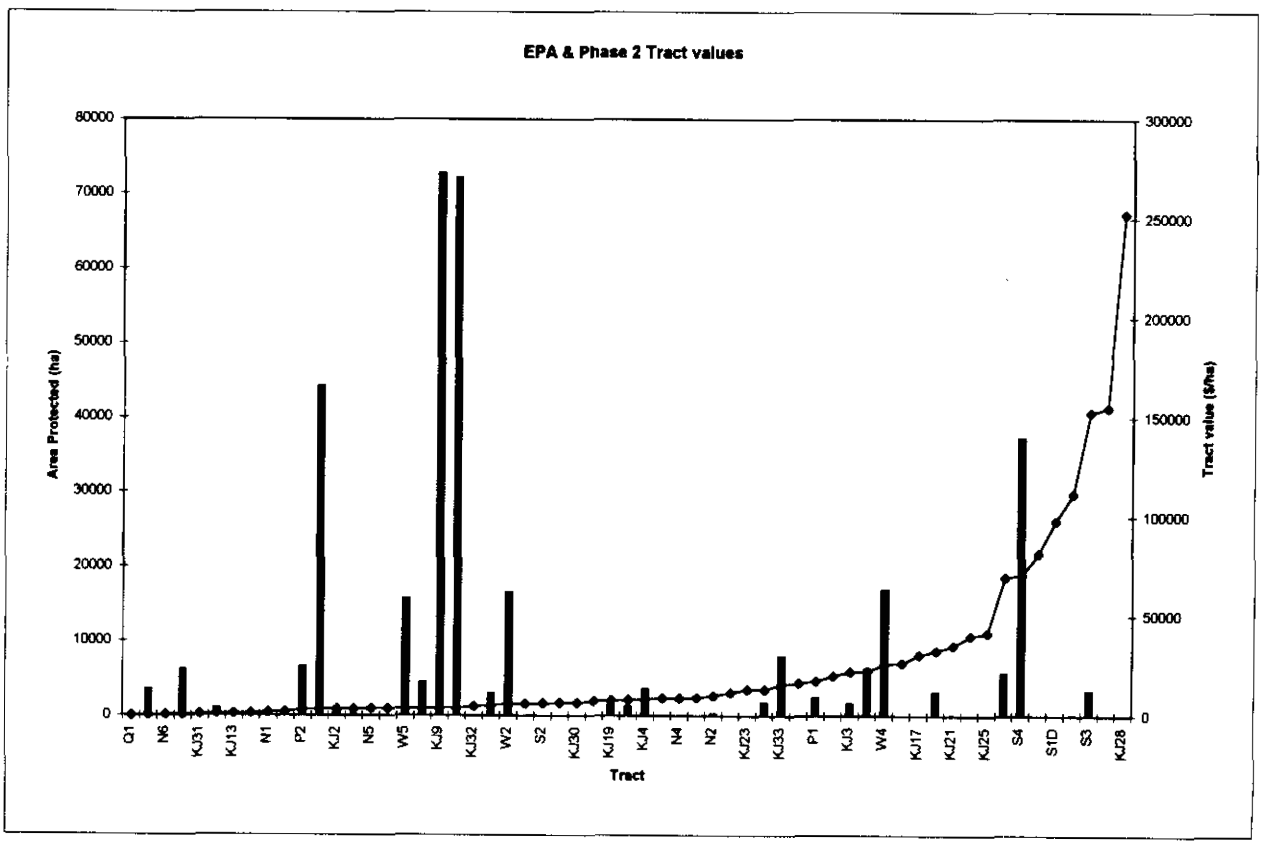

Figure 10. Existing protected areas and phase 2 tract values, Vancouver Island CORE region.

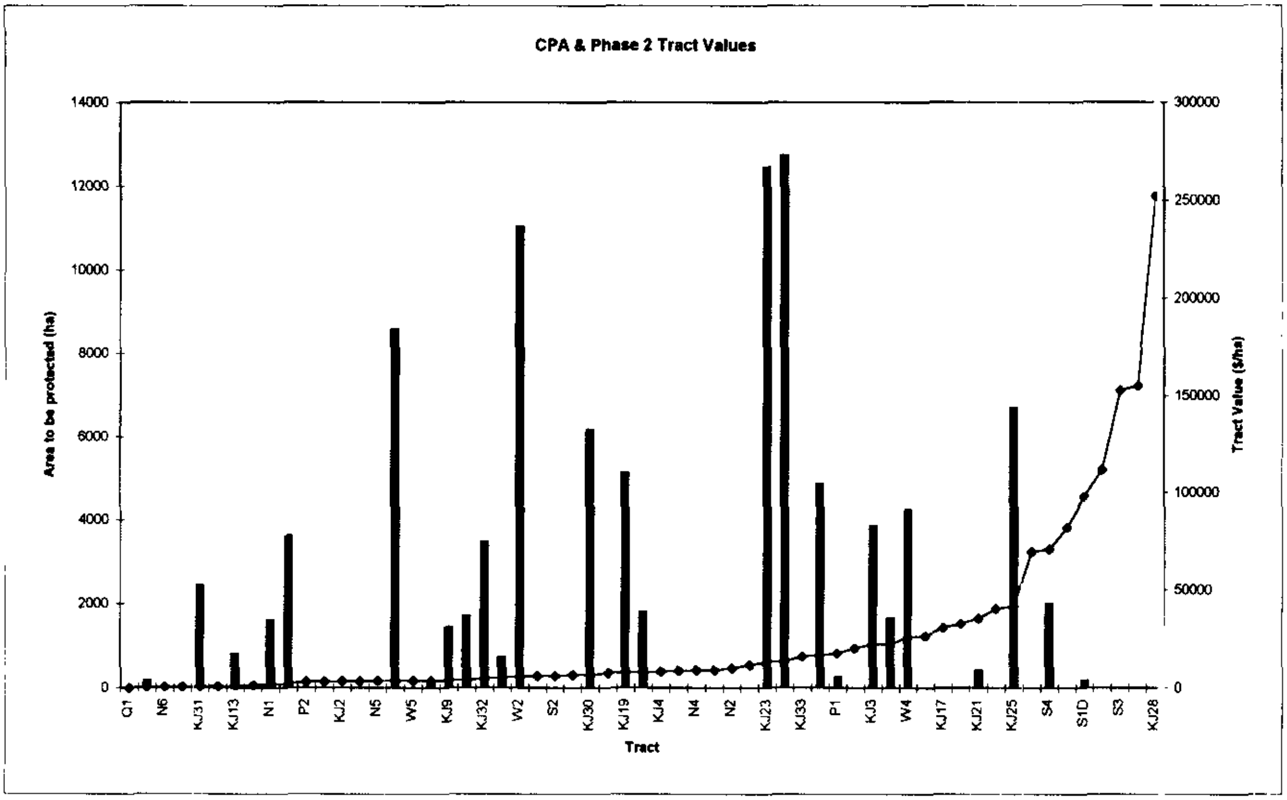

Figure 11. Proposed protected areas and phase 2 tract values, Vancouver Island CORE region.

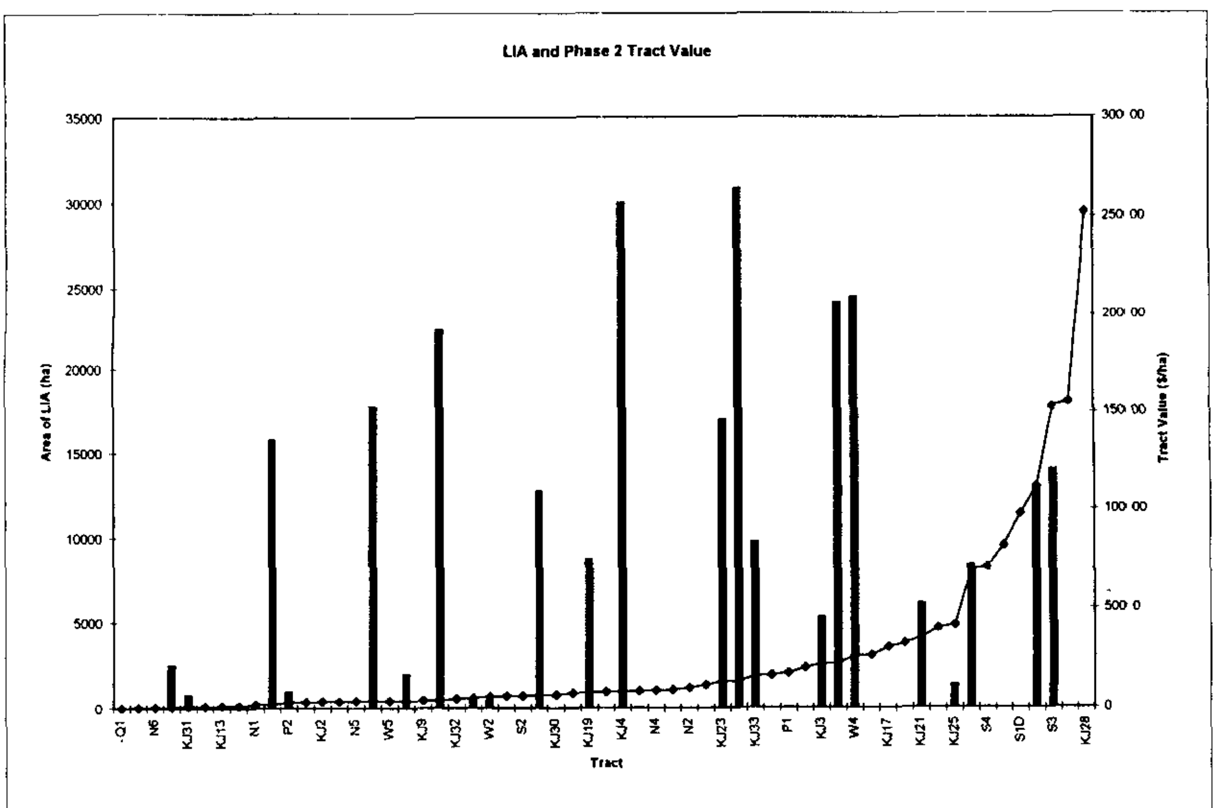

Figure 12. Low intensity areas and phase 2 tract values, Vancouver Island CORE region.

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