Chapter 8 Disposal Facilities for Solid Industrial Non-Hazardous Waste
Chapter 9 Legal Framework for Solid Industrial Non-Hazardous Waste Management in the Metropolitan Region
Chapter 10 Outlines of a Plan of Action and an Institutional Strategy for Solid Industrial Non-Hazardous Waste Management

H.2 Technical System for ISW

H.2.1 Analysis of the Data obtained from Manifest System

a. Declaration Form

In order to manage ISW in the Metropolitan Region (MR), a manifest system has been established in 1993 through the D&M's RISPEL study. The ISW declaration form consists of three parts: the first one is aimed at the producer of waste; the second one is intended for the transporter; and the third one is targeted to the final receiver of waste. The declaration form includes the following information regarding producers, as well as transporters and receivers of waste:

- name of the company;
- RUT number;
- identification number;
- person responsible for filling out the form;
- address;
- telephone and fax number;
- comments;
- signature of the person who is responsible and date;
- description of waste (producer);
- total amount transported and received;
- identification of vehicle (patent) that transports the waste; and
- identification of the destination plant of the waste (producer).

A data base was developed by the D&M's RISPEL study. The above-mentioned data obtained and processed from January to October 1994 were briefly analyzed in this section to understand the present ISWM in the MR.

b. Data Obtained from Waste Producer

As described the above, the manifest system consists of three parts and information on ISWM comes from the three sources. Information from the waste producer is the most important one.

There were 510 factories reporting information on their ISWs in accordance with the declaration system. Although their address was put into the data base, information concerning the number of employees were available only for less than 10 % of factories.

The waste collection and transportation systems from waste producers are divided into the following 3 categories:

i. Individual transportation
The ISW is transported to disposal sites by factories themselves and/or private consignors.

ii. Municipal collection
The ISW is collected and transported to the municipal landfills by municipal solid waste collection system.

iii. Recycling
The ISW is sold and/or collected by recyclers for recycling.

Table H.2.1a shows the total amount of wastes reported from the 510 factories for 10 months from January to October 1994. According to the table waste discharge from 510 factories are

-	Individual transportation:	6,927 ton/month
-	Municipal collection:	292 ton/month
-	Recycling:	1,556 ton/month
	Total	**8,775** ton/month

Tables H.2.1b, H.2.1c and H.2.1d present detailed information concerning wastes transported by the individual transportation system. Tables H.2.1e, H.2.1f and H.2.1g are information of wastes transported by the municipal collection system and tables H.2.1h, H.2.1i and H.2.1j shows it for wastes collected for recycling. The findings by the information is described as follows:

- 3,896 (individual: 2,740, municipal: 467 and recycling: 689) reports per month on average came from 510 factories.
- Although 3 main municipal landfills (Lo Errazuriz, Lepanto and Cerros de Renca) shared 63 % (4,392 ton/month) of the individual transportation and 86 % (250 ton/month) of the municipal collection as the destination of waste, there were many other destinations even in the municipal collection. Those destination should be examined.
- There were several landfills including 3 main landfills as destination of wastes for recycling. Those should be examined.

c. Data from Transporter

A list of transporters registered for waste transportation from factories to final destinations are tabulated in Table H.2.1k. There were 10 factories who had their own transportation at present in the data base and 65 transporters registered and consigned by factories. Total numbers of vehicles were 11 for factories and 181 for 65 transporters. Only 3 transporters among 75 have 10 or more units of vehicles and majority (50 among 75) have only one vehicle registered. Amount of wastes transported by them was derived from the interview survey and presented in Annex F.

d. Data from Final Receiver

Since there are no treatment facilities in the MRS at present, the final destination of wastes transported are landfills. There were 12 landfills registered in the data base as shown in Table H.2.1l, but only 7 landfills were reporting their received amount of wastes (see Table H.2.1m). There were big differences between the amount of wastes reported by producers and those from final receivers as shown in Table H.2.1n. Those unclear points were examined in the Survey on Private SWM Enterprises and presented in Annex F.

Table H.2.1a Amount of Wastes Reported from 510 Factories from Jan. to Oct. 1994

	CIIU Code	Collection System			Total	Average (kg/month)
		Individual Transportation	Municipal Collection	Recycling		
High Potential Industries	3211	1,865,861	99,918	3,966,886	5,932,665	593,266.5
	3231	1,440,210	33,714	39,012	1,512,936	151,293.6
	3319	0	0	1,594	1,594	159.4
	341	2,848,375	705,947	467,751	4,022,073	402,207.3
	3420	644,421	36,763	887,661	1,568,845	156,884.5
	351	2,755,860	114	220,219	2,976,193	297,619.3
	352	2,084,095	108,594	238,576	2,431,265	243,126.5
	354	29,360	0	0	29,360	2,936.0
	355	949,897	2,086	180,801	1,132,784	113,278.4
	356	912,719	18,940	155,053	1,086,712	108,671.2
	362	103,830	0	127,690	231,520	23,152.0
	3699	6,450,190	0	0	6,450,190	645,019.0
	371	12,722,138	2,268	552,789	13,277,195	1,327,719.5
	372	794,734	22,788	1,379,540	2,197,062	219,706.2
	381	826,405	229,862	3,151,948	4,208,215	420,821.5
	382	10,948,097	61,110	14,680	11,023,887	1,102,388.7
	383	1,816,027	14,229	435,097	2,265,353	226,535.3
	384	429,705	9,859	327,012	766,576	76,657.6
	385	29,200	0	0	29,200	2,920.0
	390	85,600	0	0	85,600	8,560.0
	62536	60,822	0	0	60,822	6,082.2
	95201	84	0	0	84	8.4
	Sub-total	47,797,630	1,346,192	12,146,309	61,290,131	6,129,013.1
Less Potential Industries	311	18,173,054	438,341	140,971	18,752,366	1,875,236.6
	312	1,035,406	1,045,613	107,967	2,188,986	218,898.6
	313	1,443,631	4,740	141,278	1,589,649	158,964.9
	3212-3219	11,173	40,836	126,291	178,300	17,830.0
	322	583,429	20,845	528,607	1,132,881	113,288.1
	3232-3233	14,880	1,617	141,287	157,784	15,778.4
	324	0	24,073	19	24,092	2,409.2
	3311-3315	0	0	1,752,854	1,752,854	175,285.4
	332	94,041	653	22,040	116,734	11,673.4
	361	119,774	0	180,165	299,939	29,993.9
	62526	0	0	267,393	267,393	26,739.3
	Sub-total	21,475,388	1,576,718	3,408,872	26,460,978	2,646,097.8
Total		69,273,018	2,922,910	15,555,181	87,751,109	8,775,110.9

Note: Unit: ton/month
Source: PROCEFF database

Table H.2.1b Amount of Wastes for Individual Transportation

Unit: Kg/month

	CIIU Code	Month										TOTAL
		1994-01	1994-02	1994-03	1994-04	1994-05	1994-06	1994-07	1994-08	1994-09	1994-10	
High Potential Industries	3211	186,300	106,475	224,627	200,936	301,742	197,631	200,850	228,550	189,800	28,950	1,865,861
	3231	100,600	146,680	155,390	141,400	146,150	158,720	195,790	172,820	136,850	85,810	1,440,210
	341	217,730	327,353	442,446	226,029	278,954	288,354	251,125	283,878	370,748	161,758	2,848,375
	3420	116,814	149,412	73,080	69,030	32,810	54,420	54,500	67,310	27,045	0	644,421
	351	212,116	280,418	288,196	327,140	272,848	232,234	310,666	353,468	311,810	166,964	2,755,860
	352	197,848	179,615	240,691	264,514	231,601	207,695	187,672	255,997	168,883	149,579	2,084,095
	354	0	0	0	27,980	0	1,380	0	0	0	0	29,360
	355	110,870	118,910	160,100	114,727	135,920	131,700	177,670	0	0	0	949,897
	356	69,749	15,983	91,453	83,115	97,514	111,231	121,311	139,793	82,041	100,529	912,719
	362	0	0	0	23,590	47,430	23,730	9,080	0	0	0	103,830
	3699	280,291	270,260	426,704	341,053	513,290	584,968	477,700	1,724,208	811,196	1,020,520	6,450,190
	371	1,283,570	1,203,245	1,399,122	1,099,560	1,336,170	1,554,009	1,493,025	1,726,514	1,278,865	348,058	12,722,138
	372	25,139	23,744	129,873	128,815	22,154	139,962	5,206	182,875	128,864	8,102	794,734
	381	202,830	40,440	46,040	96,670	97,330	83,390	93,730	78,435	43,176	44,364	826,405
	382	1,115,042	380,900	1,100,406	1,064,947	1,256,417	1,068,856	1,181,748	1,144,653	1,337,958	1,297,170	10,948,097
	383	169,914	159,778	205,452	193,942	220,671	203,139	181,047	271,405	210,679	0	1,816,027
	384	93,170	28,000	64,080	28,500	44,320	55,290	29,850	36,150	25,000	25,345	429,705
	385	0	0	2,500	5,120	2,340	2,770	7,000	3,600	1,850	4,020	29,200
	390	7,500	12,500	7,500	7,500	8,800	6,600	8,800	11,000	8,800	6,600	85,600
	62536	0	0	0	0	0	0	0	0	54,495	6,327	60,822
	95201	0	0	84	0	0	0	0	0	0	0	84
	Sub-total	4,389,483	3,443,713	5,057,744	4,444,568	5,046,461	5,106,079	4,986,770	6,680,656	5,188,060	3,454,096	47,797,630
Less Potential Industries	311	1,400,241	1,646,549	2,161,367	2,339,404	2,160,202	1,835,744	2,081,320	2,013,413	1,548,347	986,467	18,173,054
	312	87,057	69,020	85,165	146,560	221,652	96,930	93,810	107,245	97,967	30,000	1,035,406
	313	238,975	128,615	279,020	231,045	117,822	139,935	135,684	134,070	36,165	2,300	1,443,631
	3212-3219	0	0	0	0	0	0	0	6,430	4,743	0	11,173
	322	61,530	49,160	66,400	72,460	52,269	62,440	62,190	79,260	77,720	0	583,429
	3232-3233	2,110	0	0	2,045	1,910	2,280	1,425	2,190	1,030	1,890	14,880
	324	0	0	0	0	0	0	0	0	0	0	0
	3311-3315	0	0	0	0	0	0	0	0	0	0	0
	332	6,285	14,590	12,525	10,900	8,740	7,871	7,550	10,140	6,960	8,480	94,041
	361	31,810	10,900	17,420	9,904	9,460	8,130	6,590	10,630	14,930	0	119,774
	Sub-total	1,828,008	1,918,834	2,621,897	2,812,318	2,572,055	2,153,330	2,388,569	2,363,378	1,787,862	1,029,137	21,475,388
	Total	6,217,491	5,362,547	7,679,641	7,256,886	7,618,516	7,259,409	7,375,339	9,044,034	6,975,922	4,483,233	69,273,018

Table H.2.1c Number of Reports for Individual Transportation

	CIIU Code	Month										TOTAL
		1994-01	1994-02	1994-03	1994-04	1994-05	1994-06	1994-07	1994-08	1994-09	1994-10	
High	3211	75	60	111	87	102	86	80	106	62	29	798
Potential	3231	33	43	43	39	35	43	54	53	38	28	409
Industries	341	85	128	188	93	114	101	91	100	143	64	1.105
	3420	67	75	56	54	28	41	40	40	16	0	417
	351	108	139	138	137	133	113	141	144	137	67	1.257
	352	247	206	268	274	287	248	278	303	204	202	2.517
	354	0	0	0	7	0	1	0	0	0	0	8
	355	102	122	150	115	124	99	105	0	0	0	817
	356	43	20	55	53	45	50	51	53	37	34	441
	362	51	61	68	91	67	76	78	71	63	0	626
	3699	165	161	200	179	266	286	241	352	278	300	2.428
	371	246	189	212	160	195	235	208	236	163	62	1.906
	372	38	37	71	64	42	73	31	81	67	34	538
	381	125	50	64	81	75	54	51	67	43	22	652
	382	173	69	184	158	171	150	166	162	178	189	1.600
	383	97	83	107	106	127	103	118	140	91	8	980
	384	44	22	36	20	34	31	25	30	25	6	273
	385	3	0	2	3	2	3	4	2	2	2	23
	390	7	9	7	7	9	8	8	10	9	8	82
	62536	0	0	0	0	0	0	10	0	7	2	19
	95201	0	0	5	0	0	0	0	0	0	0	5
	Sub-total	1,707	1,474	1,965	1,728	1,856	1,801	1,780	1,950	1,563	1,057	16.881
Less	311	745	824	1.067	1.061	1.009	901	798	859	729	338	8.331
Potential	312	40	33	39	54	51	55	51	48	57	10	438
Industries	313	114	111	166	141	91	92	94	107	61	1	978
	3212-3219	0	0	0	0	0	0	0	1	2	0	3
	322	24	23	30	31	33	29	29	47	34	0	280
	3232-3233	8	0	0	8	8	9	10	9	6	9	67
	324	3	0	0	0	0	0	0	0	0	0	3
	3311-3315	8	10	5	4	9	13	10	12	12	0	83
	332	8	28	47	49	45	32	33	34	20	11	307
	361	6	2	3	2	2	2	1	2	4	0	24
	Sub-total	956	1,031	1.357	1.350	1,248	1.133	1.026	1.119	925	369	10.514
	Total	2,663	2,505	3,322	3,078	3,104	2,934	2,806	3,069	2,488	1,426	27.395

Table H.2.1d Destination of Wastes for Individual Transportation

Destination	Month										TOTAL
	1994-01	1994-02	1994-03	1994-04	1994-05	1994-06	1994-07	1994-08	1994-09	1994-10	
BOTADERO AV. BRASIL	251,700	353,166	328,700	164,570	0	0	0	0	0	0	1,098,136
BOTADERO LA MONTAÑA	540	360	900	1,140	980	1,660	870	1,020	11,319	0	18,789
BOTADERO PANAM. NORTE KM.14	240,050	233,690	321,490	158,370	145,110	0	0	0	308,070	0	1,406,780
CALERA DE TANGO PARC. 15	1,135	1,477	1,224	1,204	0	0	0	1,812	0	0	6,852
CAMINO LONQUEN	280,291	267,430	295,900	254,817	399,620	513,460	407,310	1,611,917	637,747	1,020,520	5,689,012
DESTINO NO IDENTIFICADO	0	0	0	0	0	665,970	185,260	0	0	0	851,230
EULOGIO GORDO Y CIA.	9,000	0	0	0	0	0	0	0	0	0	9,000
FUNDO SAN PEDRO	62,975	101,825	102,660	110,540	128,523	84,455	190,745	0	0	77,240	858,963
LO ERRAZURIZ	2,169,230	1,997,300	3,107,732	3,088,394	3,055,926	2,656,626	2,365,753	2,569,135	2,040,094	2,462,433	25,512,623
PALMAS LO ERRAZURIZ	1,216,430	503,720	1,280,110	1,278,240	1,452,537	1,244,540	1,373,172	1,364,460	1,502,890	254,768	11,470,867
PATIO MONTERREY - SID. AZA	132,020	80,180	38,260	67,500	560,810	159,900	767,100	1,082,710	374,500	0	3,262,980
REUTILIZACION PAPEL Y CARTON	0	0	0	0	27,000	0	0	0	0	0	27,000
REUTILIZACION DE MADERA	0	0	0	0	0	0	0	0	0	0	0
VARIOS DESTINATARIOS	47,864	95,107	13,507	2,000	0	0	0	0	0	0	158,478
VERTEDERO LEPANTO	492,005	441,385	484,890	498,715	581,036	436,004	492,580	690,290	507,750	192,725	4,817,380
VERTEDERO NO IDENTIFICADO	0	0	0	0	0	219,254	0	134,350	136,890	0	490,494
VERTEDEROS CERROS DE RENCA	1,314,251	1,286,907	1,704,268	1,631,396	1,266,974	1,277,540	1,592,549	1,588,340	1,456,662	475,547	13,594,434
TOTAL	6,217,491	5,362,547	7,679,641	7,256,886	7,618,516	7,259,409	7,375,339	9,044,034	6,975,922	4,483,233	69,273,018

Table H.2.1e Amount of Wastes for Municipal Collection

Unit: Kg/month

	CIIU Code	Month										TOTAL
		1994-01	1994-02	1994-03	1994-04	1994-05	1994-06	1994-07	1994-08	1994-09	1994-10	
High Potential Industries	3211	1,539	2,717	6,105	2,697	25,500	17,610	26,580	9,920	7,250	0	99,918
	3231	0	0	5,100	4,200	0	6,294	10,620	4,050	3,450	0	33,714
	341	5,629	6,714	4,631	488	500	560	687,040	385	0	0	705,947
	3420	6,517	4,400	7,778	2,021	3,599	1,689	1,629	2,473	6,449	208	36,763
	351	60	0	0	0	0	54	0	0	0	0	114
	352	12,255	2,926	24,013	9,090	11,373	14,415	8,509	8,426	13,996	3,591	108,594
	355	212	233	242	238	226	282	206	222	225	0	2,086
	356	2,492	4,640	1,206	1,397	1,801	2,896	2,062	2,281	165	0	18,940
	371	0	0	696	380	331	0	0	361	500	0	2,268
	372	0	1,660	2,340	1,925	2,521	3,630	4,856	5,856	0	0	22,788
	381	103,605	24,113	6,574	49,579	17,243	11,027	5,523	4,954	4,945	2,299	229,862
	382	9,000	2,600	10,980	11,130	0	27,400	0	0	0	0	61,110
	383	0	1,580	0	1,920	1,700	1,500	2,959	0	2,030	2,540	14,229
	384	391	360	361	355	366	2,074	5,230	402	160	160	9,859
	Sub-total	141,700	51,943	70,026	85,420	65,160	89,431	755,214	39,330	39,170	8,798	1,346,192
Less Potential Industries	311	23,080	25,910	40,326	26,020	26,539	64,059	84,351	77,126	60,280	10,650	438,341
	312	3,098	17,052	126,222	108,595	210,651	156,925	243,662	179,254	154	0	1,045,613
	313	0	0	0	0	0	0	4,740	0	0	0	4,740
	3212-3219	0	5,500	2,000	12,971	972	1,056	1,146	11,851	1,209	4,131	40,836
	322	939	1,942	2,488	3,137	2,593	2,377	2,256	2,289	2,824	0	20,845
	3232-3233	148	76	174	291	219	231	141	160	157	20	1,617
	324	547	6,799	2,456	2,460	2,214	2,471	2,664	2,572	1,890	0	24,073
	332	106	68	49	58	74	59	100	78	61	0	653
	Sub-total	27,918	57,347	173,715	153,532	243,262	227,178	339,060	273,330	66,575	14,801	1,576,718
	Total	169,618	109,290	243,741	238,952	308,422	316,609	1,094,274	312,660	105,745	23,599	2,922,910

Table H.2.1f Number of Reports for Municipal Collection

	CIIU Code	Month										Total
		1994-01	1994-02	1994-03	1994-04	1994-05	1994-06	1994-07	1994-08	1994-09	1994-10	
High	3211	8	15	17	23	23	26	26	17	4	0	159
Potential	3231	0	0	1	1	0	2	2	1	1	0	8
Industries	341	16	14	15	12	12	13	21	13	0	0	116
	3420	33	34	45	22	37	22	22	23	16	8	262
	351	5	0	0	0	0	1	0	0	0	0	6
	352	110	71	134	117	129	115	117	124	125	38	1,080
	355	13	13	13	12	12	15	13	12	12	0	115
	356	19	29	15	15	30	30	24	27	1	0	190
	371	0	0	2	1	1	0	0	1	1	0	6
	372	0	8	12	7	9	10	12	12	0	0	70
	381	68	42	48	40	43	59	37	42	25	30	434
	382	6	5	21	6	0	9	0	0	0	0	47
	383	0	4	0	4	4	4	5	0	4	5	30
	384	14	13	15	13	14	24	40	14	1	1	149
	Sub-total	292	248	338	273	314	330	319	286	190	82	2,672
Less	311	34	39	38	40	40	108	81	52	25	10	467
Potential	312	19	23	58	55	70	74	73	50	13	0	435
Industries	313	0	0	0	0	0	0	2	0	0	0	2
	3212-3219	0	2	1	4	2	1	2	7	1	4	24
	322	33	54	64	72	63	60	42	63	51	0	502
	3232-3233	6	6	10	17	11	11	9	11	11	2	94
	324	24	65	56	44	31	45	39	37	32	24	397
	332	9	9	9	9	9	6	9	9	8	0	77
	Sub-total	125	198	236	241	226	305	257	229	141	40	1,998
	Total	417	446	574	514	540	635	576	515	331	122	4,670

Table H.2.1g Destination of Wastes for Municipal Collection

Unit: Kg/month

Destination	Month										Total
	1994-01	1994-02	1994-03	1994-04	1994-05	1994-06	1994-07	1994-08	1994-09	1994-10	
BOTADERO LA MONTAÑA	0	0	0	0	0	0	0	174	0	0	174
CALERA DE TANGO PARC. 15	0	0	0	0	0	5,929	2,561	0	0	0	8,490
DESTINO NO IDENTIFICADO	87,531	22,938	28,451	30,469	28,530	6,630	13,636	1,432	225	4,131	223,973
FUNDO SAN PEDRO	60	0	0	0	0	0	0	0	0	0	60
LO ERRAZURIZ	32,524	46,090	88,031	150,852	143,605	107,035	225,046	171,386	24,633	15,634	1,004,836
REUTILIZACION DE PLASTICOS	0	0	16,760	0	0	0	0	0	165	0	16,925
REUTILIZACION DE TELAS Y FIBRAS	0	0	0	0	242	224	0	0	0	0	466
REUTILIZACION PAPEL Y CARTON	0	0	0	0	559	0	0	0	710	0	1,269
VARIOS DESTINATARIOS	36,968	32,545	25,736	34	0	0	0	60	0	0	95,343
VERTEDERO LEPANTO	0	0	0	0	12,000	0	28	48	0	0	12,076
VERTEDERO NO IDENTIFICADO	0	0	0	130	0	23,945	32,895	12,003	4,262	223	73,458
VERTEDEROS CERROS DE RENCA	12,535	7,717	84,763	57,467	123,486	172,846	820,108	127,557	75,750	3,611	1,485,840
Total	169,618	109,290	243,741	238,952	308,422	316,609	1,094,274	312,660	105,745	23,599	2,922,910

Table H.2.1h Amount of Wastes for Recycling

Unit: Kg/month

	CIIU Code	Month										Total
		1994-01	1994-02	1994-03	1994-04	1994-05	1994-06	1994-07	1994-08	1994-09	1994-10	
High	3211	23.907	38.946	3.375.512	63.310	127.306	109.135	112.145	86.794	23.677	6.154	3.966.886
Potential	3231	11.030	2.459	6.000	0	14.400	2.930	535	0	1.658	0	39.012
Industries	3319	1.594	0	0	0	0	0	0	0	0	0	1.594
	341	60.644	13.622	70.789	70.353	101.514	56.827	72.602	10.523	10.877	0	467.751
	3420	124.305	136.105	129.162	109.293	124.293	167.733	27.849	45.041	2.673	21.207	887.661
	351	23.668	23.767	22.511	30.556	31.033	23.794	26.979	3.000	24.338	10.573	220.219
	352	59.460	28.290	23.483	29.815	38.821	21.149	10.725	13.540	13.293	0	238.576
	355	0	0	0	0	0	0	180.801	0	0	0	180.801
	356	6.520	11.189	15.594	35.391	17.849	19.434	18.900	15.726	14.450	0	155.053
	362	0	8.070	58.640	60.980	0	0	0	0	0	0	127.690
	371	33.300	28.756	54.910	59.031	88.102	89.326	48.143	58.479	45.344	47.398	552.789
	372	80.440	158.560	136.120	7.660	299.271	17.354	206.035	66.650	323.060	84.390	1.379.540
	381	244.286	192.447	433.891	532.253	365.007	404.304	364.563	304.323	219.427	91.447	3.151.948
	382	0	860	760	5.580	4.880	0	2.600	0	0	0	14.680
	383	26.737	41.510	4.000	20.713	72.974	62.910	96.580	101.675	3.000	5.000	435.097
	384	3.050	34.599	4.136	103.770	16.388	16.702	19.830	29.284	99.253	0	327.012
	385	0	0	0	0	0	0	0	0	0	0	0
	62536	0	0	0	0	0	0	0	0	0	0	0
	Sub-total	669.154	643.071	4.327.372	1.004.222	1.212.476	911.986	1.071.877	604.076	678.797	261.169	12.146.309
Less	311	440	3.790	0	6.050	26.831	13.660	31.550	41.740	9.800	7.110	140.971
Potential	312	3.276	1.012	1.395	2.383	3.731	35.259	29.495	14.383	17.053	0	107.967
Industries	313	76.029	14.205	1.471	10.677	16.977	2.399	10.512	9.008	0	0	141.278
	3212-3219	2.433	16.879	23.721	13.696	44.167	2.368	3.261	10.932	8.834	0	126.291
	322	30.030	16.859	66.040	47.869	106.225	63.308	113.600	44.238	0	40.438	528.607
	3232-3233	141.287	0	0	0	0	0	0	0	0	0	141.287
	324	19	0	0	0	0	0	0	0	0	0	19
	3311-3315	299.610	226.219	258.880	280.080	217.295	155.272	126.557	117.359	45.182	26.400	1.752.854
	332	13.340	0	1.200	400	3.000	1.600	1.800	400	300	0	22.040
	361	10.660	22.190	21.320	11.370	31.900	27.125	21.950	17.070	16.580	0	180.165
	62526	0	36.614	0	50.682	0	52.569	45.329	43.948	38.251	0	267.393
	Sub-total	577.124	337.768	374.027	423.207	450.126	353.540	384.054	299.078	136.000	73.948	3.408.872
Total		1.246.278	980.839	4.701.399	1.427.429	1.662.602	1.265.526	1.455.931	903.154	814.797	335.117	15.555.181

Table H.2.1i Number of Reports for Recycling

	CIIU Code	Month										TOTAL
		1994-01	1994-02	1994-03	1994-04	1994-05	1994-06	1994-07	1994-08	1994-09	1994-10	
High Potential Industries	3211	23	22	36	28	55	41	46	43	32	4	330
	3231	3	2	4	0	6	1	1	0	2	0	19
	3319	8	0	0	0	0	0	0	0	0	0	8
	341	27	15	44	28	30	50	33	12	15	0	254
	3420	81	78	79	87	78	124	17	27	2	7	580
	351	18	9	45	26	37	24	20	10	21	11	221
	352	79	62	75	65	155	68	49	31	23	0	607
	355	0	0	0	0	0	0	494	0	0	0	494
	356	7	11	13	26	20	20	22	20	15	0	154
	362	0	1	8	7	0	0	0	0	0	0	16
	371	9	8	13	15	20	16	12	18	17	20	148
	372	25	42	28	6	58	8	70	13	11	10	271
	381	79	50	99	106	112	84	88	89	75	28	810
	382	0	1	1	1	1	0	1	0	0	0	5
	383	20	21	1	4	38	35	47	49	1	2	218
	384	14	15	18	21	4	8	6	16	12	0	114
	385	0	1	0	0	0	0	0	0	0	0	1
	62536	0	0	1	0	0	0	0	0	0	0	1
	Sub-total	393	338	465	420	614	479	906	328	226	82	4,251
Less Potential Industries	311	1	2	0	3	35	15	30	48	12	8	154
	312	12	4	6	7	14	17	16	15	21	0	112
	313	36	6	61	63	24	17	33	25	8	0	273
	3212-3219	11	40	54	37	55	49	121	6	2	0	375
	322	22	15	32	24	30	45	59	23	0	20	270
	3232-3233	8	0	0	0	0	0	0	0	0	0	8
	324	7	0	0	0	0	0	0	0	0	0	7
	3311-3315	119	131	108	102	116	95	82	86	30	14	883
	332	20	1	5	1	15	8	12	2	2	0	66
	361	3	6	4	3	6	6	5	6	4	0	43
	62526	0	62	0	63	0	77	80	85	80	0	447
	Sub-total	239	267	270	303	295	329	438	296	159	42	2,638
	Total	632	605	735	723	909	808	1,344	624	385	124	6,889

Table H.2.1j Destination of Wastes for Recycling

Unit: kg/month

Destination	Month										TOTAL
	1994-01	1994-02	1994-03	1994-04	1994-05	1994-06	1994-07	1994-08	1994-09	1994-10	
DESTINO NO IDENTIFICADO	1,486	12,154	3,456,770	29,201	918,988	38,967	123,684	9,078	3,717	0	4,594,045
LO ERRAZURIZ	243,054	150,382	42,130	2,400	1,300	81,140	18,530	0	0	0	538,936
REUTILIZACION CHATARRA	7,960	153,363	161,297	761,469	445,241	472,463	548,414	527,050	671,814	227,585	3,976,656
REUTILIZACION DE GOMAS Y CAUCHO	0	0	0	0	0	0	827	0	0	0	827
REUTILIZACION DE MADERA	0	51,170	21,065	346,159	22,652	245,601	357,151	223,886	83,933	33,510	1,385,127
REUTILIZACION DE PLASTICOS	3,980	3,340	844	24,513	22,583	45,161	166,683	46,926	22,220	694	336,944
REUTILIZACION DE TELAS Y FIBRAS	3,083	20,907	24,889	47,699	26,607	67,187	50,836	38,514	18,353	7,622	305,697
REUTILIZACION DE VIDRIO	0	8,070	58,640	72,032	11,500	8,918	24,740	7,530	10,735	0	202,165
REUTILIZACION PAPEL Y CARTON	15,490	18,310	85,850	229,526	274,717	309,505	238,416	127,590	43,082	51,463	1,393,949
VARIOS DESTINATARIOS	1,000,682	639,232	857,910	32,913	0	0	1,260	0	11,900	0	2,543,897
VERTEDERO LEPANTO	0	20	140	0	0	0	0	0	0	0	160
VERTEDERO NO IDENTIFICADO	0	0	0	6,000	25,360	76,196	41,800	53,537	51,296	19,243	273,432
VERTEDEROS CERROS DE RENCA	330	0	0	0	3,016	0	0	0	0	0	3,346
TOTAL	1,276,065	1,056,948	4,709,535	1,551,912	1,751,964	1,345,138	1,572,341	1,034,111	917,050	340,117	15,555,181

Table H.2.1k List of Registered Transporters

Nro.	*1	NOMBRE FAN	TELETONO1	DIRECCION	COMUNA	*2
1	A	ACEROS COX LTDA.	779 8192	JUANA WEBER 4866	ESTACION CENTRAL	1
2	A	BARZELATTO Y CIA.		Avda. Pdte. Edo. Frei 3981	Conchali	1
3	A	ENRIQUE PONTILLO		AVDA. EINSTEIN 670		1
4	A	GENERADOR				2
5	A	MAIPOLENO S.A.		AVDA. EINSTEIN 1071		1
6	A	MATRA LTDA.	555 1698	SANTA ELENA 1511	SANTIAGO	1
7	A	MUEBLES CARREÑO	773 7238			1
8	A	PROCOBEL LTDA.		CARRASCAL 3585	QUINTA NORMAL	1
9	A	PRODUCTOS ROCHE	623 1322	AVDA. QUILIN 3750	MACUL	1
10	A	RICHMOND LTDA.	558 1543	LAGO LLANQUIHUE 0491	SAN BERNARDO	1
					Sub-total	11
11	B	ALDO VARAS		ALMIRANTE LATORRE 9580	SAN RAMON	1
12	B	ALFONSO PAREJA I.	528 0337			1
13	B	AMPARO BRICEÑO	779 4930	JOTABECHE 869	SANTIAGO	1
14	B	ARMANDO CARO		NUEVA SAN MARTIN 215-A	MAIPU	4
15	B	CARLOS DONOSO R.	552 2252	URETA COX 144		2
16	B	CESAR FLORES	850 1829	TOCORNAL 228	PUENTE ALTO	2
17	B	COMERCIAL ARGENTA	773 6724	LOS ANDES 4323	QUINTA NORMAL	2
18	B	DAGORRET	683 2575	PEDRO AGUIRRE CERDA 4375		2
19	B	DEMARCO				3
20	B	DIEGUEZ Y DIEGUEZ	238 3766	CABO 2do. JULIO PAVEZ O. 6109		7
21	B	DISAL LTDA.		RODRIGO DE ARAYA 2330	MACUL	3
22	B	ENASA	525 3407	YUNGAY 0515		1
23	B	ERIKA SAELFELD	527 3966	SANTA MARGARITA 0331		4
24	B	FELIPE FUENTES		LAS PARCELAS 5509		1
25	B	FERNANDO SOLIS G.	773 2308	J JOAQUIN PEREZ 4809	QUINTA NORMAL	1
26	B	FOSA QUICK	779 4823	GENERAL VELASQUEZ 1845		1
27	B	FRANCISCO DE LA VAL	850 1426	DOMINGO TOCORNAL 391	PUENTE ALTO	1
28	B	GERMAN SEPULVEDA		PASAJE ROSA RIQUELME 3998		1
29	B	HIDRAGUA	273 4960	JORGE ALESSANDRI 277	LA REINA	2
30	B	HUMBERTO TRONCOSO	625 4747			3
31	B	JORGE FUENTES C.	521 4483	DEPARTAMENTAL 1338		1
32	B	JOSE ARACENA S.		AVDA. LAS AMERICAS 136	CERRILLOS	1
33	B	JOSE MALUENDA B.		A. E. WILLIAMS 700	CERRILLOS	1
34	B	JOSE ZUÑIGA	526 5375	COMBARBALA 0722		1
35	B	JUAN HERNANDEZ	532 1807	AGUADA SUR 1374		1
36	B	JULIO HOMED				1
37	B	JULIO YAÑEZ	773 5912	COMANDANTE CHACON 5891		1
38	B	KENNETH HOWARD	850 5897	PARCELA EL BOSQUE	PIRQUE	1
39	B	LIMPIAFOSA LTDA.	776 2628	EMB. QUINTANA 4455		3
40	B	LUIS CAMPOS C.	858 1486	SAN MARTIN 243	SAN BERNARDO	1
41	B	LUIS RIVERA	741 6564	PALENA 886		1
42	B	LUIS SAGREDO		PARCELA 35-B LINDEROS	BUIN	1
43	B	MANUEL PAVEZ S.	527 8537	TIL TIL 1816 POB. LIBERTAD	SAN RAMON	1
44	B	MULTIASEO	776 4155	PELAYO BEZANILLA 4154	ESTACION CENTRAL	36
45	B	MULTICERRILLOS	533 1077	LO ERRAZURIZ 126	CERRILLOS	9
46	B	MULTITRANSER	779 3767	BUINAY 1231		1
47	B	NELSA PALACIOS DIAZ	851 2718	RAFAEL ALBERTI 721		3
48	B	ORLANDO DIAZ		VASCONGADO 5302		2
49	B	PARTICULARES				27
50	B	PATRICIO VALDES	525 1043	PARROQUIA 1507		1
51	B	PEDRO GAJARDO	533 1077	AVDA. LO ERRAZURIZ 126	CERRILLOS	1
52	B	PELANTARO	779 5553	PJE. PELANTARO 714		1
53	B	RESITER	558 3215	JOSE JOAQUIN PRIETO 9750		5
54	B	ROBINSON PAVEZ				1
55	B	RODOLFO OÑATE M.	858 5182	GARCIA MORATO 434		1
56	B	SEGALL-ORTEGA	528 3577	CAMINO LA VARA PARCELA 02		10
57	B	SENEL NIETO SALINAS	531 0629	J.M. ALDUNATE 2454	MAIPU	2
58	B	SERLIMPIO	222 2112	ANGAMOS 286		9
59	B	STARKO S.A.	736 2022	PANAMERICANA NORTE 4241		3
60	B	TOPAN LTDA.	274 1786	CAUPOLICAN 1002	PROVIDENCIA	1
61	B	TRANS. MARIA LUCERO		FREIRE 136	SAN BERNARDO	1
62	B	TRANSPORTES CAMPOS		A. BENAVIDES 2966		2
63	B	TRANSPORTES CHANA	239 5173	DR. JOHOW 877 CASA I	ÑUÑOA	1
64	B	TRANSPORTES IBN	556 1355	FRANKLIN 200		2
65	B	WEINBERGER SERVICIO	2381119	LAS DALIAS 2212	MACUL	1
					Sub-total	181
					Total	192

Note: *1: A means transporter is factory himself and B for consigner
*2: Number of vehicle registered

Table H.2.1l Final Waste Receive(Landfills) for ISW

Nro.	NOMBRE FAN	TELEFONO1	DIRECCION	COMUNA	REP LEGAL
1	EMERES*	741 3956	AV. LAS REJAS SUR 1616	ESTACION CENTRAL	FRANCISCO ZIGUERUELLO
2	VERTEDERO LEPANTO*	695 2551	CAMINO LOS MORROS S/N	SAN BERNARDO	FLORENCIO VELASCO
3	EPU LTDA.* STRADALE	274 1786	CAUPOLICAN 1002	PROVIDENCIA	GUILLERMO FERNANDEZ
4	CAMINO LONQUEN	557 2111	CAMINO A MELIPILLA 6087	MAIPU	
5	FUNDO SAN PEDRO		FUNDO SAN PEDRO	SAN FCO. MOSTAZAL	JAIME XARPELL
6	BOTADERO AV. BRASIL		AV. BRASIL 854	RENCA	
7	BOTADERO PANAM.NORTE		PANAMERICANA NORTE KM. 14	COLINA	
8	OTROS DESTINATARIOS				
9	PALMAS LO ERRAZURIZ				
10	PATIO MONTERREY-AZA		LA UNION 3070	RENCA	CARLOS CAPETILLO ADAMS
11	BOTADERO LA MONTANA				
12	CALERA DE TANGO		CALERA DE TANGO PARCELA 15	CALERA DE TANGO	VICTOR MANUEL BASCUR OYARZUN

Table H.2.1m Amount of Wastes Reported by Final Receivers

Unit: kg/month

LANDFILL	1994-01	1994-02	1994-03	1994-04	1994-05	1994-06	1994-07	1994-08	1994-09	TOTAL
BOTADERO AV. BRASIL	260,790	351,200	359,100	0	459,460	0	0	0	0	1,430,550
BOTADERO PANAM. NORTE KM.14	60,001	0	0	0	0	0	0	0	0	60,001
CAMINO LONQUEN	280,145	269,010	299,770	246,640	393,960	0	0	0	0	1,489,525
FUNDO SAN PEDRO	50,135	101,825	0	0	120,475	0	179,745	0	7,500	459,680
LO ERRAZURIZ	3,869,640	3,241,475	4,374,831	3,999,110	3,837,858	6,495	0	10,274	6,840	19,346,523
PATIO MONTERREY - SID. AZA	132,020	80,180	83,450	0	91,900	151,990	0	0	0	539,540
VERTEDERO LEPANTO	437,323	377,215	414,485	0	0	5,454	0	0	0	1,234,477
TOTAL	5,090,054	4,420,905	5,531,636	4,245,750	4,903,653	163,939	179,745	10,274	14,340	24,560,296

Table H.2.1n Amount of Wastes Reported by Producers and Final Receivers

Unit: Kg/month

DESTINATION	1. Individual Transportation	2. Mu nicipal Collection	3. Recycling c2	Wastes Amount from Producer	Wastes Amount from Final Receiver	Differences
BOTADERO AV. BRASIL	1,098,136	0	0	1,098,136	1,430,550	-332,414
BOTADERO LA MONTAÑA	18,789	174	0	18,963	0	0
BOTADERO PANAM. NORTE KM.14	1,406,780	0	0	1,406,780	60,001	1,346,779
CALERA DE TANGO PARC. 15	6,852	8,490	0	15,342		
CAMINO LONQUEN	4,668,492	0	0	4,668,492	1,489,525	3,178,967
DESTINO NO IDENTIFICADO	851,230	219,842	4,594,045	5,665,117	0	0
EULOGIO GORDO Y CIA.	9,000	0	0	9,000	0	0
FUNDO SAN PEDRO	781,723	60	0	781,783	459,680	322,103
LO ERRAZURIZ	23,050,190	989,202	538,936	24,578,328	19,346,523	5,231,805
PALMAS LO ERRAZURIZ	11,216,099	0	0	11,216,099	0	0
PATIO MONTERREY - SID. AZA	3,262,980	0	0	3,262,980	539,540	2,723,440
REUTILIZACION CHATARRA	0	0	3,749,071	3,749,071	0	0
REUTILIZACION DE GOMAS Y CAUCHO	0	0	827	827	0	0
REUTILIZACION DE MADERA	0	0	1,351,617	1,351,617	0	0
REUTILIZACION DE PLASTICOS	0	16,925	336,250	353,175	0	0
REUTILIZACION DE TELAS Y FIBRAS	0	466	298,075	298,541	0	0
REUTILIZACION DE VIDRIO	0	0	202,165	202,165	0	0
REUTILIZACION PAPEL Y CARTON	27,000	1,269	1,342,486	1,370,755	0	0
VARIOS DESTINATARIOS	158,478	95,343	2,543,897	2,797,718	0	0
VERTEDERO LEPANTO	4,624,655	12,076	160	4,636,891	1,234,477	3,402,414
VERTEDERO NO IDENTIFICADO	490,494	73,235	254,189	817,918	0	817,918
VERTEDEROS CERROS DE RENCA	13,118,887	1,482,229	3,346	14,604,462	0	14,604,462
Total	64,789,785	2,899,311	15,215,064	82,904,160	24,560,296	58,343,864

H.2.2 ISWM On-site (In-Factory)

a. Introduction

Identification of the present condition of ISWM on-site is conducted based on the factory survey done by the Study Team for 199 ISW generators. Some results of the EWI's RISNOR Study is also incorporated although it was not presented in the Report. This section discusses about ISWM on-site with the following respects :

- flue gas and waste water treatment
- in-factory ISW recycling
- other in-factory ISWM handling
- consigned ISW handling
- hazardous ISW handling

b. Flue Gas and Waste Water Treatment

Flue gas and waste water treatment is in close connection with production process of the factories. According to the Team's Factory survey, heat charging processes (HCP) such as boilers, furnaces, heating, incineration etc., are used by 82% (164) of the surveyed sample. From the sample of surveyed industries, 81% use water in its productive process. Flue gas treatment may be needed in the factory having HCP while waste water treatment may be required in the factory having watering process (WP). In this regard, the Study picked up the factories of having HCP and WP respectively and examined the installation rate of flue gas and waste water treatment equipment. Table H.2.2a and H.2.2b show the results of the examination.

Table H.2.2a Present Flue Gas Treatment On-site

Industrial Category	Number of factories with HCP	Number of factories with FGT (existing)	Number of factories with FGT (planned)
Highly potential industry	75	30 (40%)	10 (13%)
Potential industry	68	24 (35%)	10 (15%)
Less potential industry	21	8 (38%)	5 (29%)
Total	164	62 (38%)	25 (15%)

About 38% of the factories having HCP are equipped with FGT (Flue Gas Treatment) and 15% have plans to install them. The remaining 47% neither have nor plan to install air emission control facilities at present. It indicates that a certain amount of dust and APC (air pollution control) products is emitted into the atmosphere without any pre-

treatment. In addition, generation of dust and APC products may be underestimated due to this insufficient in-factory air emission management.

Table H.2.2b Present Conditions of Waste Water Treatment

Industrial category	Number of factories with WP	Number of factories with WWT (existing)	Number of factories with WWT (planned)
Highly potential industry	75	34 (45%)	14 (19%)
Potential industry	67	35 (52%)	20 (30%)
Less potential industry [1]	19	14 (74%)	10 (52%)
Total	161	83 (52%)	44 (27%)

Note : The reason why the sum of the number of factories with existing WWT and planned WWT exceeds the total number of factories with WP is that some of factories with no WP also have WWT or its plan.

In the case of waste water treatment, it has to be taken into account that regardless of production process, factories may need to treat waste water for non-industrial use. However, special attention is to be paid to the result that about 36% of the factories which have high potential of generating hazardous substances do not treat waste water. In addition, the Team's factory survey also indicated that 4.4% of the total gener ated waste are directly discharged into sewer or watercourse. For high potential factories of generating hazardous wastes, the ratio reached as much as 12.4%. Such inappropriate practices may potentially increase the danger of water pollution. In-factory waste water treatment should be immediately enforced by establishing the related legal and regulatory frameworks. Moreover, it is also kept in mind that sludge handling will become another issue if waste water treatment is widely applied by factories.

Flue gas and waste water treatment by each type of industry is given in Table H.2.2c on next page.

Table H.2.2c Conditions of Flue Gas and Waste Water Treatment by each Type of Industry

Industrial Category	CIIU Code	Nos. of Surveyed Industries	Production Process						Pollution Control Facilities									
									Existing						Planned			
			Nos. of Industries With HCP	Rate of Industries With HCP	Nos of Industries With Watering	Rate of Industries With Watering	Storage Facilities for Liquid Chemicals	Rate (%)	Nos. of Factories With FGT	Rate (%)	Nos. of Factories With WWT	Rate (%)	Other	Rate (%)	Nos. of Factories With FGT	Rate (%)	Nos. of Factories With WWT	Rate (%)	Other	Rate (%)
Highly	351	6	5	83%	4	67%	4	67%	1	20%	1	25%	2	50%	0	0%	0	0%	1	25%
Potential	352	26	22	85%	25	96%	23	88%	6	27%	11	44%	7	30%	3	14%	4	16%	0	0%
Industries	354	4	4	100%	2	50%	3	75%	2	50%	1	50%	0	0%	0	0%	1	50%	0	0%
	356	13	7	54%	10	77%	8	62%	1	14%	3	30%	2	25%	0	0%	1	10%	0	0%
	371	7	7	100%	7	100%	2	29%	7	100%	1	14%	1	50%	3	43%	0	0%	1	50%
	372	4	3	75%	4	100%	3	75%	2	67%	2	67%	1	33%	1	33%	1	25%	1	33%
	381	32	27	84%	23	72%	18	56%	11	41%	15	65%	1	6%	3	11%	7	30%	1	6%
Total Highly Potential Industries		**92**	**75**	**82%**	**75**	**82%**	**61**	**66%**	**30**	**40%**	**34**	**45%**	**14**	**23%**	**10**	**13%**	**14**	**19%**	**4**	**7%**
Potential	3211	17	15	88%	16	94%	14	82%	5	33%	6	38%	3	21%	2	13%	4	25%	2	14%
Industries	3231	4	2	50%	2	50%	2	50%	1	50%	4	200%	0	0%	0	0%	2	100%	0	0%
	3319	1	1	100%	0	0%	1	100%	1	100%	0	0%	1	100%	0	0%	0	0%	0	0%
	341	10	7	70%	7	70%	4	40%	3	43%	5	71%	1	25%	1	14%	4	57%	0	0%
	3420	8	7	88%	7	88%	2	25%	0	0%	1	14%	2	100%	2	29%	2	29%	1	50%
	355	5	5	100%	5	100%	2	40%	1	20%	1	20%	1	50%	2	40%	0	0%	1	50%
	362	4	4	100%	3	75%	2	50%	3	75%	1	33%	0	0%	1	25%	1	33%	0	0%
	3699	2	2	100%	1	50%	0	0%	1	50%	1	100%	1	0%	1	50%	1	100%	1	0%
	382	7	5	71%	6	86%	3	43%	4	80%	3	50%	1	33%	1	20%	2	33%	0	0%
	383	7	6	86%	4	57%	1	14%	3	50%	5	125%	0	0%	0	0%	1	25%	0	0%
	384	6	4	67%	4	67%	4	67%	1	25%	3	75%	1	25%	0	0%	1	25%	0	0%
	385	2	2	100%	1	50%	1	50%	1	50%	0	0%	0	0%	0	0%	1	100%	1	100%
	390	1	0	0%	1	100%	0	0%	0	0%	1	100%	0	0%	0	0%	0	0%	1	0%
	625	3	0	0%	2	67%	0	0%	0	0%	2	100%	1	0%	0	0%	0	0%	0	0%
	952	8	8	100%	8	100%	4	50%	0	0%	2	25%	1	25%	0	0%	1	13%	0	0%
Total Potential Industries		**85**	**68**	**80%**	**67**	**79%**	**40**	**47%**	**24**	**35%**	**35**	**52%**	**13**	**33%**	**10**	**15%**	**20**	**30%**	**7**	**18%**
Less	311	9	8	89%	7	78%	5	56%	3	38%	7	100%	3	60%	1	13%	3	43%	0	0%
Potential	313	3	3	100%	3	100%	3	100%	3	100%	1	33%	1	33%	2	67%	3	100%	0	0%
Industries	3212 - 3219	1	1	100%	1	100%	1	100%	0	0%	0	0%	0	0%	1	100%	1	100%	0	0%
	322	5	5	100%	4	80%	3	60%	1	20%	4	100%	0	0%	1	20%	2	50%	1	33%
	324	2	2	100%	2	100%	2	100%	0	0%	0	0%	1	50%	0	0%	0	0%	0	0%
	3691 - 3696	1	1	100%	1	100%	0	0%	0	0%	1	100%	1	0%	0	0%	1	100%	0	0%
	410	1	1	100%	1	100%	1	100%	1	100%	1	100%	0	0%	0	0%	0	0%	0	0%
Total Less Potential Industries		**22**	**21**	**95%**	**19**	**86%**	**15**	**68%**	**8**	**38%**	**14**	**74%**	**6**	**40%**	**5**	**24%**	**10**	**53%**	**1**	**7%**
Grand Total		**199**	**164**	**82%**	**161**	**81%**	**116**	**58%**	**62**	**38%**	**83**	**52%**	**33**	**28%**	**25**	**15%**	**44**	**27%**	**12**	**10%**

Note: HCP (Heat Charging Process)
FGT (Flue Gas Treatment)
WWT (Waste Water Treatment)

c. In-factory Recycling of ISW

According to the result of the factory survey done by the Study Team, the ratio of in-factory recycling amount is approximately 10% of the total ISW generation of the 199 factories surveyed. However, according to the EWI's RISNOR study it is about 21%, According to the Team's survey the percentage distribution of in-factory recycling by type of waste is shown in Table H.2.2d below.

Table H.2.2d Percentage Distribution of In-Factory Recycling by Type of Waste

Waste code	Waste type	Amount Recycled (tons/month)	Ratio to Total (%)
C-2	Dust and APC (Air pollution control)	99.0	5.3
C-4	Organic sludge	330.0	17.6
C-8	Solvents	6.6	0.4
C-10	Inorganic chemical residues	0.1	0.0
C-11	Organic chemical residues	60.0	3.2
C-12	Other liquid waste	134.6	7.2
C-14	Glass and ceramic waste	559.3	29.8
C-15	Metal and scrap	31.0	1.6
C-16	Paper and cardboard	20.1	1.1
C-17	Plastics	31.0	1.6
C-18	Rubber	8.0	0.4
C-22	Slag from melting	75.0	4.0
C-23	Construction waste	1.0	0.1
C-24	Other solid waste	524.0	27.9
Total		1879.7	100.2

Remark: The sum of percentage distribution may not be 100% due to rounding of the figures.

Glass and ceramic wastes are recycled the most inside the factories, which is followed by organic sludge. Regarding the ratio of in-factory recycling to the generation is given in Table H.2.2e on next page.

Table H.2.2e In-factory Recycling Ratio for Each Type of Waste

Waste code	Type of waste	Generation (tons/month)	In-factory recycling (tons/month)	In-factory recycling ratio (%)
C-2	Dust and APC	140.2	99.0	70.6
C-4	Organic sludge	894.8	330.0	36.9
C-8	Solvents	13.9	6.6	47.5
C-10	Inorganic chemical residues	826.4	0.1	0.0
C-11	Organic chemical residues	300.6	60.0	20.0
C-12	Other liquid waste	134.6	134.6	100.0
C-14	Glass and ceramic waste	1186.6	559.3	47.1
C-15	Metal and scrap	1422.5	31.0	2.2
C-16	Paper and cardboard	2727.7	20.1	0.7
C-17	Plastics	638.1	31.0	4.9
C-18	Rubber	269.6	8.0	3.0
C-22	Slag from melting	461.0	75.0	16.3
C-23	Construction waste	29.6	1.0	3.4
C-24	Other slid waste	524.0	524.0	100.0

In-factory recycling ratio is the highest in C-12 other liquid waste and C-24 other solid waste of 100%, which are followed by C-2 dust and APC products of about 70% and C-8 solvents and glass/ceramic wastes of 47%. The wastes that are not given in the table above is not recycled in factories as far as accepting the answers of the interviewees of the Team's factory survey. It has to be taken into account that, however, the Team concluded more than 50% in total (on-site and outside factories) of ISW generated are recycled at present based on the analysis of both the Team and EWI's RISNOR study. Detailed conditions of in-factory waste recycling for each type of industries is given in Table H.2.2f on the next page.

Table H.2.2f Conditions of In-factory Waste Recycling by Type of Industries

CIIC	Category	Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total	
			Ash	Dust	Ino Sldg	Org Sldg	Asbest	Acid	Alkali	Solvent	Oily	Ino Chem	Org Chem	Liquid	Food	Glass	Metal	Paper	Plastic	Rubber	Textile	Domestic	Wood	Slag	Constr	Others		%
351	Manufacture of industrial chemical products	6												88.0													88.0	4.7
352	Manufacture of other chemical products	26								5.5				46.6				20.0	12.0								84.1	4.5
354	Oil & coal products	4																									0.0	0.0
356	Other non-classified plastic products	13																									0.0	0.0
371	Iron & steel industries	7															20.0							75.0			95.0	5.1
372	Basic metal industries	4		9.0																							9.0	0.5
381	Manufacture of metal products exc mach &eq	32															11.0	0.1									11.1	0.6
7	Sub Total	92	0.0	9.0	0.0	0.0	0.0	0.0	0.0	5.5	0.0	0.0	0.0	134.6	0.0	0.0	31.0	20.1	12.0	0.0	0.0	0.0	0.0	75.0	0.0	0.0	287.2	15.3
	(%)		0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	7.2	0.0	0.0	1.6	1.1	0.6	0.0	0.0	0.0	0.0	4.0	0.0	0.0	15.3	
3211	Textile processing & materials manufacturing	17																									0.0	0.0
3231	Leather tanning & finishing	4																									0.0	0.0
3319	Other non-classified wooden products	1																									0.0	0.0
341	Paper, printing & publishing industries	10				330.0							60.0												1.0		391.0	20.8
3420	Printing, photoengraving, publishing & likes	8								1.0										7.5							8.5	0.5
355	Manufacture of rubber products	5																		0.5							0.5	0.0
362	Glass & glass products	4		90.0												116.2											206.2	11.0
3699	Other non-metallic mineral products	2																								524.0	524.0	27.9
382	Manufacture of machinery exc electrical	7										0.1															0.1	0.0
383	Manufacture of electrical machinery	7														372.1											372.1	19.8
384	Manufacture of transport equipment	6																									0.0	0.0
385	Manufacture of science, measuring, controlling equipment(inc lens	2																									0.0	0.0
390	Other manufacturing industries	1																									0.0	0.0
625	Gasoline filling station	3																									0.0	0.0
952	Laundries & dry cleaners	8								0.1																	0.1	0.0
15	Sub Total	85	0.0	90.0	0.0	330.0	0.0	0.0	0.0	1.1	0.0	0.1	60.0	0.0	0.0	488.3	0.0	0.0	0.0	8.0	0.0	0.0	0.0	0.0	1.0	524.0	1502.5	79.9
	(%)		0.0	4.8	0.0	17.6	0.0	0.0	0.0	0.1	0.0	0.0	3.2	0.0	0.0	26.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.1	27.9	79.9	
311	Food manufacturing	9																									0.0	0.0
313	Beverage industries	3														71.0			19.0								90.0	4.8
322	Garment industries	6																									0.0	0.0
324	Leather footwears	2																									0.0	0.0
3691	Manufacture of non-metallic mineral products	1																									0.0	0.0
410	Generatoin, transmission and distribution of electric energy	1																									0.0	0.0
6	Sub Total	22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	71.0	0.0	0.0	19.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	90.0	4.8
	(%)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	
28	Total	199	0.0	99.0	0.0	330.0	0.0	0.0	0.0	6.6	0.0	0.1	60.0	134.6	0.0	559.3	31.0	20.1	31.0	8.0	0.0	0.0	0.0	75.0	1.0	524.0	1879.7	100.0
	(%)		0.0	5.3	0.0	17.6	0.0	0.0	0.0	0.4	0.0	0.0	3.2	7.2	0.0	29.8	1.6	1.1	1.6	0.4	0.0	0.0	0.0	4.0	0.1	27.9	100.0	

d. Treatment, Final Disposal and Long-term Storage On-site

In the Team's factory survey, the following aspects on in-factory ISWM is surveyed:

- In-factory intermediate treatment
- Final disposal at factory's compound and/or its property land
- Long-term storage at factory's compound awaiting external treatment/disposal

da. In-factory Intermediate Treatment

In-factory intermediate treatment is one of the important parts of waste minimization by generators and the results of the Team's survey is presented in Tables H.2.2g and H.2.2h. According to the results of the survey (see Table H.2.2h), most of ISW (82.6%) generated on-site are not treated. Among the treated ISW (17.4%), 10.1% of them are recycled on-site. Thus, only 7.3% of ISW generated are treated on-site (at the generation). Popular treatment methods on-site are neutralization (2.8%), sorting (1.8%) and drying/evaporation (1.7%) in order and the other methods are negligible. Table H.2.2i indicated the percentage of intermediate treatment inside factories for each type of wastes.

Table H.2.2g Internal Treatment Methods in Factory (Amount obtained)

Unit: ton/month

ISW Category		Treatment Methods												
		1	2	3	4	5	6	7	8	9	10	11	(blank)	Grand Total
C-1	Ash including from incinerator	-	25.0	-	-	-	-	55.0	-	-	-	-	43.7	123.7
C-2	Dust and APC products	-	12.5	0.3	-	0.6	-	-	-	-	99.0	6.2	21.6	140.2
C-3	Inorganic sludge	-	284.3	-	-	-	-	-	-	-	-	-	300.5	584.8
C-4	Organic sludge	2.8	-	5.4	-	-	-	-	-	-	330.0	28.2	528.4	894.8
C-5	Asbestos	-	-	-	-	-	-	-	-	-	-	-	15.0	15.0
C-6	Acids	-	-	40.1	-	-	-	-	-	-	-	-	412.7	452.8
C-7	Alkalis	-	-	63.3	-	-	-	-	-	-	-	8.5	9.7	81.5
C-8	Solvents	-	-	-	-	-	-	-	-	-	6.5	0.1	7.4	13.9
C-9	Oily waste	-	-	-	-	0.7	-	-	0.1	0.0	-	1.8	27.7	30.3
C-10	Inorganic chemical residues	-	-	400.0	-	-	-	-	-	-	0.1	-	426.5	826.6
C-11	Organic chemical residues	12.0	-	5.0	-	-	-	-	-	-	60.0	-	223.6	300.6
C-12	Other liquid waste	-	-	-	-	-	-	-	-	-	134.6	-	-	134.6
C-13	Waste from food production	-	-	-	-	-	-	46.9	-	-	-	6.4	5,095.7	5,149.0
C-14	Glass and ceramics	-	-	-	-	-	0.1	40.2	-	-	559.3	-	587.0	1,186.6
C-15	Metal and scrap	-	-	-	-	-	0.5	34.9	-	-	31.0	5.0	1,351.1	1,422.5
C-16	Paper and cardboard	-	-	-	0.1	-	0.1	10.8	-	-	20.1	8.0	2,688.7	2,727.7
C-17	Plastics	-	-	-	-	-	5.0	100.1	-	-	31.0	88.0	414.0	638.1
C-18	Rubber	-	-	-	-	-	5.0	-	-	-	8.0	-	256.7	269.7
C-19	Textile and leather	-	-	-	-	-	10.0	4.3	-	-	-	-	237.9	252.2
C-20	Waste similar to domestic waste	-	-	1.1	-	0.3	-	0.2	-	-	-	1.2	1,080.9	1,083.7
C-21	Wood	-	-	-	-	-	-	36.2	-	-	0.0	-	1,252.8	1,288.9
C-22	Slag form melting	-	-	-	-	-	-	-	-	10.0	75.0	-	376.0	461.0
C-23	Construction Waste	-	-	-	-	-	-	0.2	-	-	1.0	-	28.4	29.6
C-24	Other solid waste	-	-	-	-	-	-	-	-	-	524.0	-	0.0	524.0
Grand Total		14.8	321.8	515.3	0.1	1.5	20.7	328.7	0.1	10.0	1,879.7	153.4	15,385.9	18,631.8

Note:
1. Dewatering
2. Drying and /or Evaportion
3. Neutralization
4. Reduction
5. Incineration
6. Crushing
7. Sorting
8. Oil Separation
9. Solidification
10. Reutilization
11. Other

Table H.2.2h Internal Treatment Methods in Factory (Rate obtained)

Unit: %

ISW Category		E												
		1	2	3	4	5	6	7	8	9	10	11	(blank)	Grand Total
C-1	Ash including from incinerator	-	20.2%	-	-	-	-	44.5%	-	-	-	-	35.3%	100%
C-2	Dust and APC products	-	8.9%	0.2%	-	0.4%	-	-	-	-	70.6%	4.4%	15.4%	100%
C-3	Inorganic sludge	-	48.6%	-	-	-	-	-	-	-	-	-	51.4%	100%
C-4	Organic sludge	0.3%	-	0.6%	-	-	-	-	-	-	36.9%	3.2%	59.0%	100%
C-5	Asbestos	-	-	-	-	-	-	-	-	-	-	-	100.0%	100%
C-6	Acids	-	-	8.9%	-	-	-	-	-	-	-	-	91.1%	100%
C-7	Alkalis	-	-	77.7%	-	-	-	-	-	-	-	10.4%	11.9%	100%
C-8	Solvents	-	-	-	-	-	-	-	-	-	46.8%	0.4%	52.7%	100%
C-9	Oily waste	-	-	-	-	2.3%	-	-	0.3%	0.1%	-	5.8%	91.5%	100%
C-10	Inorganic chemical residues	-	-	48.4%	-	-	-	-	-	-	0.0%	-	51.6%	100%
C-11	Organic chemical residues	4.0%	-	1.7%	-	-	-	-	-	-	20.0%	-	74.4%	100%
C-12	Other liquid waste	-	-	-	-	-	-	-	-	-	100.0%	-	-	100%
C-13	Waste from food production	-	-	-	-	-	-	0.9%	-	-	-	0.1%	99.0%	100%
C-14	Glass and ceramics	-	-	-	-	-	0.0%	3.4%	-	-	47.1%	-	49.5%	100%
C-15	Metal and scrap	-	-	-	-	-	0.0%	2.5%	-	-	2.2%	0.4%	95.0%	100%
C-16	Paper and cardboard	-	-	-	0.0%	-	0.0%	0.4%	-	-	0.7%	0.3%	98.6%	100%
C-17	Plastics	-	-	-	-	-	0.8%	15.7%	-	-	4.9%	13.8%	64.9%	100%
C-18	Rubber	-	-	-	-	-	1.9%	-	-	-	3.0%	-	95.2%	100%
C-19	Textile and leather	-	-	-	-	-	4.0%	1.7%	-	-	-	-	94.3%	100%
C-20	Waste similar to domestic waste	-	-	0.1%	-	0.0%	-	0.0%	-	-	-	0.1%	99.7%	100%
C-21	Wood	-	-	-	-	-	-	2.8%	-	-	0.0%	-	97.2%	100%
C-22	Slag form melting	-	-	-	-	-	-	-	-	2.2%	16.3%	-	81.6%	100%
C-23	Construction Waste	-	-	-	-	-	-	0.7%	-	-	3.4%	-	95.9%	100%
C-24	Other solid waste	-	-	-	-	-	-	-	-	-	100.0%	-	0.0%	100%
Grand Total		0.1%	1.7%	2.8%	0.0%	0.0%	0.1%	1.8%	0.0%	0.1%	10.1%	0.8%	82.6%	100%

Note:
1. Dewatering
2. Drying and /or Evaportion
3. Neutralization
4. Reduction
5. Incineration
6. Crushing
7. Sorting
8. Oil Separation
9. Solidification
10. Reutilization
11. Other

Table H.2.2i Percentage of In-factory Intermediate Treatment of ISW for each Type of Wastes

Type of waste	Percentage of intermediate treatment by methods (%)			
Ash	Drying and/or evaporation 20.2%		Sorting 44.5%	
Dust and APC	Drying and/or evaporation 8.9%	Neutralization 0.2%	Incineration 0.4%	Others 4.4%
Inorganic sludge	Drying and/or evaporation 48.6%			
Organic sludge	Dewatering 0.3%	Neutralization 0.6%	Others 3.2%	
Acids	Neutralization 8.9%			
Alkalis	Neutralization 77.7%		Others 10.4%	
Solvents	Others 0.4%			
Oily waste	Incineration 2.3%	Oil separation 0.3%	Solidification 0.1%	Others 5.8%
Inorganic chemical residues	Neutralization 48.4%			
Organic chemical residues	Dewatering 4.0%		Neutralization 1.7%	
Waste from food	Sorting 0.9%		Others 0.1%	
Glass & ceramics	Sorting 3.4%			
Metal & scrap	Sorting 2.5%		Others 0.4%	
Paper & cardboard	Sorting 0.4%		Others 0.3%	
Plastics	Crushing 0.8%	Sorting 15.7%	Others 13.8%	
Rubber	Crushing 1.9%			
Textile & leather	Crushing 4.0%		Sorting 1.7%	
Domestic wastes	Neutralization 0.1%		Others 0.1%	
Wood	Sorting 2.8%			
Slag from melting	Solidification 2.2%			
Construction waste	Sorting 0.7%			

Remark: Reutilization is not categorized above as intermediate treatment.

As found in the table above, neutralization of liquid type wastes and drying of sludge seems to be widely applied inside factories for waste minimization.

db. Final Disposal at Factory's Compound And/or its Property Land

According to the Team's survey results (see Table H.2.2j), only about 3% of the total generation amount is disposed of at factory's compound and/or its property. Such disposal is carried out by the factories of chemical, metal, non-metal mineral, and rubber products, and textile industries. As a whole, however, ISW final disposal on-

site does not seem popular in MR.

dc. Long-term Storage at Factory's Compound Awaiting External Treatment/disposal

Storage of ISW seems to be temporal for most of factories. Long-term storage can be slightly found in iron & steel, glass products, and metal products factories. In the future, however, storage facility will become necessary to temporarily store the increasing ISW generation mainly due to the installation of flue gas and waste treatment equipment in factories.

e. Consigned ISW Handling

The Team's factory survey indicates that a large amount of ISW generated is handled by the consigned ISW handling agents. Consigned treatment is categorized into the following types :

- Consigned transport of ISW to the municipal landfill
- Consigned treatment and disposal of ISW (treatment & disposal methods are unknown)
- Reutilization by other parties, e.g. use at other factory as raw material etc.

The ratio of the above consigned ISW handling to the total generation is given in Table H.2.2j.

Table H.2.2j Ratio of Consigned handling of ISW

Type of Industry	Consigned transport of ISW to municipal landfill	Consigned treatment and disposal of ISW (unknown treatment / disposal methods)	Reutilization by other parties (use at other factory's raw material, etc.)	Total consigned ISW handling
High Potential Industry	30.1%	9.4%	29.8%	69.3%
Potential Industry	32.4%	1.8%	53.8%	88.0%
Less Potential Industry	8.7%	1.1%	73.9%	83.7%
Total	22.6%	3.3%	56.2%	82.1%

As found in the table, most of the generated ISW is handled by the consigned agents. In most of the cases, however, the methods of treatment and disposal is hard to be identified due to the difficulty of tracing ISW consigned. It may be possible that some

amount of ISW transported to municipal landfill is hazardous. Some of consigned agents may inappropriately treat or dispose waste. Reutilization is also doubtful because there is no available data on reutilization and recycling of ISW by the agents. In addition, the Team's another survey on private SWM enterprises indicated that some of ISW collected by recycling agents were inappropriately treated and disposed of. Regarding the consigned handling of ISW, therefore, further detailed survey on the treatment and disposal by the agents is needed to make clearer identification of hazardous waste handling.

f. Conditions of Hazardous ISW Handling

The number factories that answered to discharge hazardous wastes is 18. The specifications of these industries are : 2 non-ferrous metal products industry of discharging lead, 4 industries of discharging chrome (1 non-ferrous metal products, leather, machinery, and electrical machinery industries), a metal industry of discharging CN, an electrical machinery industry of discharging organic phosphorous, and 10 factories of discharging solvents and/or pigments, etc..

Some of factories stated that hazardous substances are pre-treated inside factory by neutralization facilities before discharging to the sewer. In addition, there are some factories equipped with moderate or even advanced pre-treatment system of hazardous wastes. However, most of old and/or small factories does not seem to have any pre-treatment facilities for hazardous wastes. Therefore, the results of Team's factory survey above may not reflect the actual conditions of hazardous waste handling in MR. Special attention is to be paid to another data on the use of raw material given in Table H.2.2k, which indicated that the factories which use the raw materials of potentially generating hazardous wastes are much more than those stated to discharge them.

Table H.2.2k Use of Raw Material by Category of Industries

Industrial Category	CIIU_A	Nos. of Survey Industries	Heavy Metals	%	Solvents	%	Acids	%	Alkalis	%	Pigments	%	Oils	%	Asbestos	%	Others	%
High	351	6	1	17%	3	50%	4	67%	3	50%	1	17%	3	50%	0	-	3	50%
Potential	352	26	1	4%	19	73%	15	58%	14	54%	19	73%	21	81%	0	-	20	77%
Industries	354	4	0	-	2	50%	2	50%	1	25%	1	25%	1	25%	1	25%	3	75%
	356	13	1	8%	9	69%	3	23%	3	23%	9	69%	7	54%	0	-	5	38%
	371	7	3	43%	5	71%	1	14%	2	29%	1	14%	5	71%	0	-	3	43%
	372	4	3	75%	3	75%	2	50%	2	50%	2	50%	2	50%	0	-	2	50%
	381	32	12	38%	15	47%	17	53%	11	34%	13	41%	24	75%	4	13%	14	44%
Total High Potential Industries		92	21	23%	56	61%	44	48%	36	39%	46	50%	63	68%	5	5%	50	54%
Potential	3211	17	1	6%	6	35%	15	88%	13	76%	14	82%	12	71%	0	-	13	76%
Industries	3231	4	3	75%	3	75%	3	75%	3	75%	3	75%	3	75%	0	-	2	50%
	3319	1	0	-	1	100%	0	-	0	-	0	-	0	-	0	-	0	-
	341	10	1	10%	6	60%	4	40%	3	30%	4	40%	5	50%	0	-	5	50%
	3420	8	3	38%	5	63%	5	63%	3	38%	6	75%	6	75%	1	13%	3	38%
	355	5	0	-	3	60%	1	20%	0	-	4	80%	5	100%	0	-	2	40%
	362	4	0	-	1	25%	3	75%	3	75%	3	75%	3	75%	0	-	1	25%
	3699	2	0	-	1	50%	0	-	0	-	0	-	1	50%	1	50%	2	100%
	382	7	1	14%	6	86%	4	57%	3	43%	2	29%	5	71%	1	14%	2	29%
	383	7	2	29%	4	57%	4	57%	4	57%	4	57%	5	71%	0	-	3	43%
	384	6	2	33%	6	100%	3	50%	2	33%	4	67%	5	83%	1	17%	2	33%
	385	2	0	-	0	-	1	50%	0	-	1	50%	2	100%	0	-	1	50%
	390	1	0	-	1	100%	0	-	0	-	1	100%	1	100%	0	-	1	100%
	625	3	0	-	0	-	0	-	0	-	0	-	1	33%	0	-	0	-
	952	8	0	-	6	75%	1	13%	2	25%	2	25%	1	13%	0	-	6	75%
Total Potential Industries		85	13	15%	49	58%	44	52%	36	42%	48	56%	55	65%	4	5%	43	51%
Less	311	9	1	11%	3	33%	6	67%	4	44%	3	33%	6	67%	1	11%	4	44%
Potential	313	3	0	-	0	-	2	67%	3	100%	0	-	1	33%	0	-	3	100%
Industries	3212 - 3219	1	0	-	1	100%	1	100%	1	100%	0	-	1	100%	0	-	0	-
	322	5	0	-	2	40%	2	40%	1	20%	0	-	3	60%	0	-	4	80%
	324	2	0	-	2	100%	1	50%	1	50%	2	100%	2	100%	0	-	2	100%
	3691 - 3696	1	0	-	0	-	0	-	0	-	1	100%	0	-	1	100%	0	-
	410	1	0	-	0	-	1	100%	1	100%	0	-	0	-	0	-	1	100%
Total Less Potential Industries		22	1	5%	8	36%	13	59%	11	50%	6	27%	13	59%	2	9%	14	64%
Grand Total		199	35	18%	113	57%	101	51%	83	42%	100	50%	131	66%	11	6%	107	54%

g. Other Findings from the Team's Factory Survey by Each Category of Industries

ga. Highly Potential Hazardous Group

Chemicals, insecticides and chemical fibers (3511 ~ 3513)

Neutralization of waste acid and alkali is applied in some of factories. But, mitigation of hazardous materials seems insufficient. Waste water treatment including chemical treatment of hazardous component is necessary for some factories.

Recycling of acid and other materials is advanced in some new and large industries.

An insecticides factory has a penetration well, in their premises, for disposing segregated hazardous liquid wastes. It should be stopped as soon as possible to avoid the groundwater and soil contamination.

Paints, medicines, soaps and other chemical products (3521 ~3529)

Cleaner production including automatic filling and packing system is introduced in some of factories. Waste water is drained to municipal sewer, and a little quantity of plastics is sent to municipal landfill. Checking hazardousness of waste water should be required at each disposal point.

Asphalt, rubber and plastic products (3540 ~ 3560)

Recycling of resources are highly performed in most of the observed factories. Some of them are operating their original waste recovering appliances.

Iron and steel industries (3710)

No blast furnaces are located in MR. There are some steelworks having electric furnaces to utilize steel ingot and scraps as raw materials, and hot strip mills producing steel shapes. Most of slags and inorganic sludges generated in these factories are utilized for paving in their premises first, and remainders are disposed through recyclers / transporters. Mostly they are sent to municipal landfill. However, some of them are observed to be disposed illegally to clay excavated holes for bricks, etc..

As for exhaust gas treatment, treatment of dust generated from electric furnace of the steel foundry visited should draw an attention of alert. Since the foundry smelts scrap steel contaminated with considerable amount of debris, ill working environment was

observed. Immediate action should be taken for workers health.

Metal products (3811 ~ 3819)

Waste acids and alkalis used for pickling are neutralized in some of factories. Zinc coating and lead coating by hot-dip method are applied. A metal products factory stated discharging CN included in inorganic sludge. 66.7% of metal scraps are recycled. 400 tons per month of inorganic chemicals are neutralized and disposed to public sewer. 143 tons per month of inorganic sludge is sent to municipal landfill.

cb. Potential Hazardous Group

Textile and leather industries (3211 ~ 3240)

There are many medium to small size old factories of these categories in densely populated areas. Most of them do not have any water treatment facilities for the waste water containing high BOD and SS load. The waste water is directly discharged to municipal sewer, like domestic waste water. If the regulation for industrial waste water disposal is strictly applied and the waste water is treated in these factories, considerable amount of organic sludge will be generated.

Wood, paper and printing industries (3319, 3411 ~ 3420)

No virgin pulp producing factories from wood (having digesting and bleaching processes) are located in this region. However, there are several factories, regenerating used papers and/or cartonboards, with pulpers, cleaners and de-inking equipment. One older factory is discharging their waste water containing about 2,000ppm SS without any treatment to the river Maipo. One relatively newer factory discharges their treated waste water with 20ppm SS to the river Mapocho. These paper regeneration factories, having no waste water treatment facilities yet, will be the potential big generation sources of organic sludge.

Recycling and cleaner production system are partly applied in the downstream paper processing industries, such as carton box manufacturers, sanitary goods manufacturers, publishers, etc..

Recycle rate of waste paper in these industries group reaches high level of 85.7%.

A large scale used paper recycling company is effectively operating, having their branch offices at several locations in the region.

Glass, non-metallic mineral products (3620, 3699)

Internal recycling is widely applied. 59% of waste glass is recycled within the industry.

Gasoline filling station (6253)

Waste oil such as exchanged engine oil is taken out by recycler. Washing water of cars is drained after decanting. Sedimented sludge is sent to municipal landfill.

Laundries and dry cleaners (9520)

Washing water goes directly to municipal sewer. Dry cleaning sludge is sent to municipal landfill.

cc. Less Potential Hazardous Group

***Food and Beverage manufacturing* (311x, 313x)**

No hazardous wastes are generated in these categories of industries. Modernization of production process, including cleaner production, automatic filling and packing, energy and resource saving, waste minimization, preparation of improved working environment, etc., is well achieved. 95.6% of waste food generated in these industries is recycled.

Thermal electric power generation (4101)

Coal-firing 100MW steam turbine generator for peak shaving purpose is the only one power plant in the Metropolitan Region. Average operating time in these 5 years was only 915.3 hours per year (10.44%). Fuel conversion to gas is under planning. No possibility of becoming a big ISW generator is expected in future.

H.2.3 External ISWM (outside of the factories)

a. Studies Used for the Identification of Present ISWM Outside Generation

In order to identify the ISWM outside generation, factories' survey and survey on private enterprises were conducted by the Team. In addition, the Team examined EWI's RISNOR study although it was not presented in the report.

aa. Factories' Survey by JICA

The survey by the Team carried out following investigations regarding waste generation, treatment/disposal by respective factories:

i. Transport and final disposal at municipal landfill by own means of transportation;
ii. Transport and final disposal at municipal landfill by consignment of private contractor;
iii. Final disposal at factory's compound and/or its property land;
iv. Long-time storage at factory's compound awaiting external treatment/disposal;
v. Discharge to sewer or watercourse;
vi. Disposal consigned to private contractor - treatment and disposal is not known;
vii. Reutilization by other parties, e.g. use at other factory as raw materials; and
viii. Others.

The outcome is shown in Table H.2.3a.

ab. EWI's RISNOR Study

Although it is not presented in the report of EWI's RISNOR Study, the study carried out following investigation regarding ISW generation and treatment/disposal at respective factories:

i. Transportation by a third party for sale;
ii. Transportation by a third party for landfill;
iii. Transportation by a third party for fee of charge;
iv. Municipal collection
v. Own transportation for sale;
vi. Own transportation for landfill;
vii. Own transportation free of charge; and
viii. Without transportation.

The Team analyzed the outcome and summarized in Table H.2.3b.

ac. Survey on Private SWM Enterprises

The survey aimed at providing further insight on the actual waste flow after generation at the industries. The survey was carried out by means of a personal interview with a knowledgeable company manager and through the completion of a survey sheet. The private enterprises registered correspond to the following three groups;

- transporters (21 enterprises)
- landfill sites (12 sites)
- recyclers (25 enterprises)

Table H.2.3a Disposal Methods On-Site Surveyed by JICA Team (Rate obtained)

Unit: %

Industrial Category		Disposal Methods									
		1	2	3	4	5	6	7	8	No Answer	Grand Total
Highly Potential Industries	351	0.4%	8.6%	-	-	0.1%	0.1%	90.7%	0.1%	0.1%	100.0%
	352	0.0%	11.7%	0.0%	0.0%	15.7%	0.4%	67.2%	3.2%	1.7%	100.0%
	354	2.5%	96.0%	-	-	-	-	-	1.5%	-	100.0%
	356	31.2%	34.8%	-	-	0.0%	0.8%	29.6%	1.6%	2.0%	100.0%
	371	15.9%	55.6%	-	3.1%	-	23.5%	-	-	1.9%	100.0%
	372	-	65.9%	-	-	1.6%	-	15.9%	-	16.6%	100.0%
	381	1.2%	17.4%	0.7%	0.8%	22.0%	4.7%	34.5%	18.2%	0.5%	100.0%
Total Highly Potential Industries		6.3%	30.1%	0.3%	1.3%	12.4%	9.4%	29.8%	8.8%	1.6%	100.0%
Potential Industries	3211	1.3%	50.2%	0.7%	-	0.9%	30.3%	13.3%	3.2%	0.2%	100.0%
	3231	0.9%	74.5%	-	-	-	-	24.6%	-	-	100.0%
	3319	-	-	-	-	-	-	100.0%	-	-	100.0%
	341	0.2%	58.2%	-	-	-	-	39.1%	-	2.5%	100.0%
	3420	-	3.1%	-	-	0.0%	6.7%	89.3%	0.1%	0.7%	100.0%
	355	98.1%	0.2%	0.2%	-	-	-	1.5%	-	-	100.0%
	362	-	61.8%	-	15.3%	-	-	6.8%	0.6%	15.5%	100.0%
	3699	-	97.3%	-	-	-	-	-	-	2.7%	100.0%
	382	2.8%	39.4%	-	-	-	-	57.3%	-	0.6%	100.0%
	383	1.4%	14.2%	-	-	0.3%	0.3%	41.9%	1.1%	40.8%	100.0%
	384	-	14.8%	-	-	-	-	85.2%	-	-	100.0%
	385	-	4.9%	-	-	-	-	94.7%	0.4%	-	100.0%
	390	-	-	-	-	-	-	100.0%	-	-	100.0%
	625	-	51.3%	-	-	-	-	38.5%	10.3%	-	100.0%
	952	0.2%	86.5%	-	-	13.1%	-	-	0.2%	-	100.0%
Total Potential Industries		3.9%	32.4%	0.0%	1.3%	0.1%	1.8%	53.8%	0.3%	6.5%	100.0%
Less Potential Industries	311	0.2%	11.7%	-	-	0.0%	3.6%	83.3%	-	1.3%	100.0%
	313	-	8.6%	-	-	6.4%	-	84.4%	0.4%	0.2%	100.0%
	322	-	35.4%	-	-	7.2%	-	57.4%	-	-	100.0%
	324	-	-	-	-	-	43.4%	-	-	56.6%	100.0%
	3691 - 3696	-	-	64.8%	-	-	-	-	35.2%	-	100.0%
	410	-	-	-	-	-	-	100.0%	-	-	100.0%
Total Less Potential Industries		0.0%	8.7%	7.2%	-	4.1%	1.1%	73.9%	4.2%	0.8%	100.0%
Grand Total		2.9%	22.6%	2.9%	0.8%	4.4%	3.3%	56.1%	3.7%	3.2%	100.0%

Note:
1. Transport and final disposal at municipal landfill by own means of transpritation.
2. Transport and final disposal at municipal landfill by consignment of private contractor.
3. Final disposal at factory's compound and/or its property land.
4. Long-time storage at factory's compound awaiting external treatment/disposal.
5. Discharge to sewer or watercourse
6. Disposal consigned to private contractor - treatment and disposal is not known.
7. Reutilization by other parties, e.g. use at other factory as raw material.
8. Others.

Table H.2.3b Disposal Methods in Factory Surveyed by EWI's RISNOR Study

Unit: ton/month

Industrial Category	CIIU	Recycled						Total Recycled	Not Recycled					Total Not Recycled	TOTAL
		1	3	4	5	7	8		2	3	4	6	8		
Highly Potential Industries	351	0.40	-	-	-	-	9.00	9.40	12.80	-	8.30	-	0.20	21.30	30.70
	352	21.44	-	-	-	-	0.13	21.57	80.96	-	3.17	-	-	84.13	105.70
	356	0.05	0.08	-	-	-	3.05	3.18	2.06	0.95	16.18	-	-	19.19	22.36
	371	60.81	0.10	-	-	48.00	302.43	411.34	1,124.38	0.07	13.30	40.52	-	1,178.27	1,589.61
	372	1.05	-	-	-	-	71.00	72.05	-	-	0.20	-	-	0.20	72.25
	381	196.10	0.30	-	3.50	-	29.98	229.87	622.98	0.08	9.57	2.78	8.00	643.41	873.29
Total Highly Potential Industries		**279.85**	**0.48**	-	**3.50**	**48.00**	**415.59**	**747.41**	**1,843.18**	**1.10**	**50.71**	**43.30**	**8.20**	**1,946.49**	**2,693.90**
Potential Industries	3211	147.11	3.28	-	-	-	32.00	182.39	205.99	-	4.13	2.17	-	212.29	394.68
	3231	45.59	-	-	-	-	-	45.59	138.54	-	11.20	7.04	-	156.78	202.37
	3319	35.18	-	-	-	-	-	35.18	-	-	0.61	8.28	-	8.89	44.06
	341	89.94	-	-	-	-	487.00	576.94	943.47	-	4.54	-	-	948.01	1,524.94
	3420	30.02	0.20	-	-	-	0.09	30.31	36.72	0.17	2.06	-	-	38.95	69.25
	355	-	-	-	-	-	2.65	2.65	43.13	-	0.87	-	-	44.00	46.65
	362	17.03	-	-	-	-	10.80	27.83	14.77	-	0.20	20.00	-	34.97	62.80
	3699	-	-	-	-	-	-	-	-	-	11.04	-	-	11.04	11.04
	382	0.22	-	-	-	-	0.12	0.34	-	-	0.40	0.06	-	0.46	0.80
	384	19.15	-	-	-	-	0.02	19.17	24.61	-	1.62	-	8.00	34.23	53.40
	385	-	-	-	-	-	-	-	2.10	-	-	-	-	2.10	2.10
	390	1.43	1.60	0.00	-	-	0.17	3.20	-	-	1.31	0.23	-	1.54	4.74
Total Potential Industries		**385.66**	**5.08**	**0.00**	-	-	**532.85**	**923.59**	**1,409.33**	**0.17**	**37.96**	**37.77**	**8.00**	**1,493.23**	**2,416.82**
Less Potential Industries	311	1,003.68	20.74	-	-	-	269.65	1,294.07	857.93	20.00	39.82	-	0.25	918.00	2,212.06
	312	34.25	-	-	-	-	0.43	34.67	17.01	-	14.22	-	-	31.23	65.90
	313	21.30	-	-	-	-	-	21.30	96.00	-	-	19.20	-	115.20	136.50
	322	9.47	0.27	-	-	-	0.04	9.77	0.35	-	5.44	-	-	5.78	15.56
	324	0.29	-	-	-	-	-	0.29	5.61	-	0.01	-	-	5.62	5.91
	332	2.21	-	-	9.70	-	25.80	37.71	2.63	-	0.80	-	-	3.43	41.13
	361	-	-	-	-	-	682.00	682.00	3.35	-	0.05	-	-	3.40	685.40
	3311 - 3315	1,616.73	14.18	-	-	-	164.75	1,795.65	0.10	-	4.46	0.50	4.85	9.91	1,805.56
	3691 - 3696	9.19	5.30	-	-	-	41.40	55.89	202.55	3.12	30.13	2.58	-	238.37	294.26
	3212 - 3219	0.18	1.30	-	-	-	10.21	11.69	-	-	1.37	-	-	1.37	13.06
Total Less Potential Industries		**2,697.28**	**41.78**	-	**9.70**	-	**1,194.27**	**3,943.04**	**1,185.52**	**23.12**	**96.27**	**22.28**	**5.10**	**1,332.29**	**5,275.33**
Grand Total		**3,362.79**	**47.33**	**0.00**	**13.20**	**48.00**	**2,142.71**	**5,614.04**	**4,438.03**	**24.39**	**184.94**	**103.35**	**21.30**	**4,772.02**	**10,386.06**
Ratio		**32.4%**	**0.5%**	**0.0%**	**0.1%**	**0.5%**	**20.6%**	**54.1%**	**42.7%**	**0.2%**	**1.8%**	**1.0%**	**0.2%**	**45.9%**	**100.0%**

Note:
1 Transportation by a third party for Sale
2 Transportation by a third party for Landfill
3 Transportation by a third party free of charge
4 Municipal Collection
5 Own transportation for Sale
6 Own transportation for Landfill
7 Own transportation for Free of Charge
8 Without Transportation

b. Storage, Collection and Transportation

ba. Storage

Source segregation is well established in general. Basically, wastes are separated in accordance with the following categories:

- waste to be recycled in the factory;
- waste to be reutilized outside the factory;
- ISW to be disposed of at municipal landfill;
- ISW to be consigned to private contractors; and
- municipal waste.

Generally, factories are well maintained with frequent cleaning. The wastes cleared up are transported from generation places to storage by carts and/or vehicles.

Specific storage areas are secured in factories; generally special yards are maintained for large factories and drums are used for smaller ones. The storage areas are maintained in good condition. According to the Table H.2.3a, the rate of long-term storage at factory's compound awaiting external treatment/disposal is 0.8% of total generation amount. Thus, the amount of it is estimated at about 7,500 ton/year.

bb. Collection and Transportation

According to the Tables H.2.3a and H.2.3b, rate of collection and transportation differs below. The amount of collection/transportation in 1995 in the table is calculated based on the total generation estimated and the rate.

Table H.2.3c Rate and Amount of Collection and Transportation in 1995

Items	JICA Survey	Estimated Amount in 1995	EWI's RISNOR Study	Estimated Amount in 1995
Collection and transportation by a third party	22.8%	214,000 ton/year	44.7%	420,000 ton/year
Collection and transportation by own means of transportation	2.9%	27,000 ton/year	1.0%	9,000 ton/year
Total	25.7%	241,000 ton/year	45.7%	429,000 ton/year

As shown in the table, due to the difference of the questionnaire used in the two studies the rate of collection/transportation obtained by the studies is quite different. However, it is concluded that more than 25% of ISW generated, i.e. 240,000 ton/year, are collected, transported and disposed of at the municipal landfills.

On the other hand, most of transporters registered in the manifest system, except for factories' own transporters, were contacted and major 21 transportation enterprises were interviewed by the Survey to the private enterprises. According to the survey results, the rate of ISW collection is shown below.

Table H.2.3d Rate and Amount of Collection by Category of Waste

Type of Waste	Rate	Amount (ton/month)
Municipal SW	81.5%	102,000
ISW	16.2%	20,300
Medical SW	1.8%	2,300
Construction Waste	0.5%	600
Total	100%	125,300

From the table, it can be said that business magnitude of collection/transportation of ISW is only 1/5 of municipal SW. This figure (20% of municipal SW) is considered quite small and the business of ISW collection/transportation is not will established. It is said that municipal SW collected is 157,000 ton/month. Based on the figure, it is estimated that ISW collection amount is 31,400 ton/month which is equivalent to 20% of municipal SW collected.

c. Treatment and Recycling

ca. Treatment

There are no treatment facilities for ISW in the MR and at present ISW generated in factories is either recycled or disposed of at landfills including an authorized ones. There are several plans, which aims at treatment and disposal of ISW including HW, being evaluated by CONAMA-RM. None of the plans are implemented.

cb. Recycling

The recycling of ISW is very common in the MR and the rate of ISW recycled is quite high.

Although surveyed items of JICA Team and EWI's RISNOR regarding waste generation and treatment/disposal were different, both studies reached the same conclusion that percentage of "recycling" of ISW is quite high. The proportion of "ISW recycled" are 56.2% in JICA Team's survey, and 54.1% in EWI's RISNOR study respectively. The outcome of both studies showed approximate values. In this regard, it might be assumed that the values are reliable.

It is concluded that more than 50% of ISW generated are recycled. However, "Survey on private SWM Enterprises" by the JICA Team and EWI's VIRS study pointed out that considerable amounts of ISW collected by recycling agents are treated and/or disposed inappropriately. Attention should be drawn to that residues of recycling works are illegally dumped in many occasions.

d. Final Disposal

As previously mentioned, more than 25% of ISW (20,000 ton/month) are collected, transported and disposed of at the municipal landfills. In addition, destinations of ISW generated in factories are either recycling or disposal of landfills at present.

There is a high degree of difficulty in obtaining information (except for the authorized landfills). In order to identify the actual situation of final disposal in the MR, all solid wastes landfills registered in the CDSI database (10 sites), except for one, were visited. (The exact location of "Calera de Tango, parcela 15" could not be established). Furthermore, three additional sites were visited which, upon consultation with the Chilean counterpart, entailed some degree of uniqueness and interest. The classification of the visited sites was conducted in the following manner:

i. Authorized: (3)

ii. Unauthorized: (9)
   a. Pure Landfills (5)
   b. Landfills with Recycling (4)

Note: in parentheses, the number of visited sites for that category

Among the 12 landfills visited, 6 landfills gave information on disposal amount as shown in Table H.2.3e. According to the information given by the present landfills, only 17,870 ton/month of ISW are disposed of at three landfills (including an unauthorized landfill which receives 870 ton/month) and this is less than the disposal amount obtained by generators. However, upon consideration of disposal amount of 6 landfills which did not give information, it is concluded again that more than 20,000

ton/month of ISW are disposed of at present landfills including unauthorized ones. This, however, indicates that some of ISW consigned to the private ISW collectors and subjected to be disposal at the 3 authorized landfills are disposed of at unauthorized landfills.

Furthermore, it can be said that most of ISW are disposed of at the two authorized municipal landfills, i.e. Cerros de Renca and Lepanto, and the biggest authorized municipal landfill in the MR, Lo Errazuris, receives very little. This is because compared with prices of the other authorized landfills (in average 1,800 Peso/ton), tipping fees of Lo Errazuriz is much more expensive (6,000 Peso/ton).

The most noteworthy figure is the long-standing existence of most unauthorized sites, ranging from 5 to 21 years into the past. The establishment of some of this sites, therefore, dates back to a period where no authorized landfills existed. However, the appearance of unauthorized landfills continued will into the late '80s, even when the first final disposal site (Cerros de Renca) had been inaugurated for more than a decade. On the contrary to sophisticated sanitary installation at the authorized landfills, a tremendous contrast with the poor conditions under unauthorized landfills are operated.

Table H.2.3e Disposal Amount at Landfills Registered in the CDSI Database

Unit : ton/month

Company Code	Cat*	Company Name	Type of Waste			Total (ton/month)	Tipping Fee (Peso/ton)		
			Municipal SW	ISW	Construction Waste		Private	Municipality	Other
1	A	EMERES (Empresa Metropolitana de Residuos Sólidos)	100,000	-	-	100,000	6,000	2,000	-
2	A	Cerros de Renca Mayors Council	35,000	15,000	-	50,000	2,200	1,051	-
3	A	Vertedero Lepanto S.A.	18,000	2,000	-	20,000	-	-	1,400
4	B	Eulogio Gord y CIA	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
5	B	Municipalidad de El Monte	13	-	-	13	The Municipality owns the landfill		
6	B	Emile Strandsky	-	870	-	870	-	-	3,165
7	B	Unidentified	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
8	B	Mineral Santa Adela	-	-	1,000	1,000	2.5 Mill. Peso/year		
9	C	José Dieguez	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
10	C	Mario Heressmann	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
11	C	Dagoberto Baeza	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
12	C	BABARIA S.A.	N/A.	N/A.	N/A.	N/A.	N/A.	N/A.	N/A.
Grand Total			153,013	17,870	1,000	171,883	-	-	-
Rate			89.0%	10.4%	0.6%	100%	-	-	-

Note : Cat* = Category of Landfill
A. Authorized Landfill
B. Unauthorized pure landfill
C. Unauthorized Landfill with Recycling
N.A. Not available

e. Illegal Dumping

Today, there are no dedicated landfills or other major treatment options for Industrial Solid Waste in the Santiago Metropolitan Region. Some of the non-hazardous industrial solid waste is accepted at the landfills as Municipal Solid Waste. Hazardous waste materials may be hidden among non-hazardous waste, but at least at the Lo Errázuriz landfill several supervisors are present at the tipping area during unloading.

According to the EWI's VIRS study, 101 illegal dumping sites with a total accumulated volume of approx. 10,200,000 cu.m. of waste have been identified in the Metropolitan Region. Approx. 45-50 of the sites receive industrial solid waste.

Table H.2.3f shows the geographical distribution and the accumulated volume of dumping grounds.

Table H.2.3f Illegal Dumping Grounds in Santiago Metropolitan Region

Province	Illegal dumping grounds		Accumulated volume	
	Nos.	%	Cu.m.	%
Santiago	64	63	5,163,022	51
Chacabuco	7	7	3,364,400	33
Cordillera	7	7	128,205	1
Maipo	11	11	767,117	7
Melipilla	5	5	262,000	3
Talagante	7	7	498,200	5
Santiago Metropolitan Region	101	100	10,182,944	100

Source: EWI's VIRS study

The majority of the dumping grounds are situated in residential areas (50%), while 18% are located in industrial areas and 32% in remote areas.

The EWI's VIRS study has assessed the total volume of the illegally dumped waste to approx. 10,200,000 cu.m. The surface area covered is approx. 7,150,000 sq.m. Construction waste is the most abundant type of illegally dumped waste. Industrial waste is deemed to occupy only 2.2% or 224,000 cu.m. distributed as follows:

- Organic material: 7%
- Paper and cardboard: 11%
- Plastics: 1%
- Glass and ceramics: 7%
- Metals: 18%
- Rubble: 3%
- Slag: 2%
- Chemical waste (41,900 cu.m.): 18%
- Others: 27%
- Not recognized: 6%

Chemical waste from other waste types is estimated to be approx. 12,100 cu.m., i.e. a total accumulated volume of approx. 54,000 cu.m.

H.3 Institutional System for ISW

H.3.1 Environmental Policy

a. Economic Policy Related to the Environment

At this time, the economic policy related to the environment is not defined, that is, there is no pragmatical document defining objectives, strategies and use of economic tools for the appropriate management of natural resources and for the development of decontamination programs and actions. Some work is presently being conducted on this matter and during the course of this year (CONAMA-1995) a document on this line of work will be published.

Some studies that have already been completed, such as "The Use of Economic Instruments in the Environmental Policy of Chile" (by V.Hartje, K. Gauer and A. Urquiza, April 1994, GTZ) and "Chile - Managing Environmental Problems: Economic Analysis of Selected Issues" (December 19, 1994, World Bank), will provide a valuable background for establishing economic policies related to the environment.

Also, the Law of Basis for the Environment and some principles like "Polluters Pay", "Sustained Development", "Cradle to Grave", "Precautionary Principle", as well as other tools such as the rights for emission transfers will contribute to obtaining the drafting of the policies.

b. Features of Environmental Problems in the Metropolitan Region

The Metropolitan Region is mainly located in a basin enclosed by mountains, inducing an atmospheric stagnation, which is especially intensified in the winter season. Rivers originated from melted snow in those mountains run into this basin, join into the Maipo river and flow to the Pacific ocean. Collateral with this surface hydrology, underground water hydrology is formed.

In these natural conditions, about 40% of the population and commercial activities of the Republic are concentrated in the Metropolitan Region. The Region also receives concentration of industrial activities. Chronic air pollution from traffic, industries and domestic fuel in winter creates serious problems and imposes political struggles. However, since large-scale mining industries and mining refinery industries do not exist in the Region, health damage problems such as arsenic poisoning derived from copper refining in other regions are not found.

Meanwhile waste water from mining, fishery product industries, paper/pulp industries, are creating water pollution problems all over the country, however, because of the following reasons, problems are not tangible or eminent in the Metropolitan Region:

i. Maipo river has large flow (about 150 m^3/s in summer and 500 m^3/s in winter) and is a rapid stream, therefore, river contamination by polluted water is not tangible.

ii. Sewerage system in urban area enables discharge of domestic waste into the mouth of the rivers, water quality problems are not visible nor sensible for the majority of citizens in the urban area.

iii. Maipo river runs directly into the Pacific ocean without having its flow slowed down by enclosed bays, coastal pollution and/or pollution of fishery products are not eminently detected in spite of significant loads of water contamination (BOD_5 4,239 ton/month in the Maipo Basin).

Since domestic waste water is discharged without sewage treatment into rivers, vegetables grown in the Maipo river basin are not edible raw, which is the only tangible main social problem in relation to water contamination at present.

c. Movement of Air Pollution Prevention and Industrial SWM Issues

As for air pollution problems, the Metropolitan Region represents the most serious

urban air pollution among other regions (apart from serious industrial pollution e.g. arsenic poisoning and respiratory diseases caused by copper refinery). Under the circumstances, air pollution prevention measures will have to be initiated in the Metropolitan Region before other regions.

Since major sources of air contamination in the Region are exhaust gas from vehicles and public welfare (house heating and boilers) (see Table H.3.1a), improvement of air contamination will not be expected shortly.

Table H.3.1a Breakdown of Source of Air Pollution Substances in the Metropolitan Region (1990)

Unit : t/year, (%)

Pollutant / Source	NOx	SOx	CO	Particulates	Organic particulates
Welfare (homes, boilers, furnaces, etc.)	5,334 (18.4)	45,748 (69.5)	10,569 (2.8)	7,030 (13.7)	3,114 (6.7)
Transportation (vehicles)	23,435 (80.8)	6,181 (9.4)	367,695 (96.2)	5,470 (10.6)	28,184 (60.5)
Industry (industrial plants)	64 (0.2)	13,885 (21.1)	1,650 (0.4)	4,510 (8.8)	7,890 (16.9)
Refuse incineration, etc.	160 (0.6)	26 (0.0)	2,380 (0.6)	440 (0.9)	850 (1.8)
Evaporated substances	0 (0)	0 (0)	0 (0)	0 (0)	6,566 (14.1)
Substances scattered from roads and earth's surface	0 (0)	0 (0)	0 (0)	33,950 (66.0)	0 (0)
Total	28,993 (100.0)	65,840 (100.0)	382,294 (100.0)	51,400 (100.0)	46,604 (100.0)

Source: "Air Pollution of Santiago" (1993, Hugo Sandoval L. et al.).

Meanwhile, since it is aimed to improve atmospheric environment by enforcing environmental standards and measures (see Table H.3.1b), it is expected that air pollution prevention of factories should also be promoted and enforced. In accordance with the movement of air pollution prevention in factories, dust derived from exhaust gas treatment and sludge from treatment by elution will be generated as ISW. The quantity of ISW as a consequence of air pollution prevention enforcement, is marginal (in total ISW) in comparison with the quantity of sludge produced in relation to water pollution prevention enforcement. However, since ISW after anti- air pollution measures include hazardous substances such as heavy metals, it requires control and

disposal as hazardous solid waste.

Table H.3.1b Comparison in Air Pollution Control Standards between Chile and Japan

Item	Chile	Japan
Nitrogen dioxide (NO_2)	0.16 ppm (24-hour average) 0.25 ppm (one-hour average)	0.04 - 0.06 ppm (one-day average)
Sulfur dioxide (SO_2)	0.14 ppm (24-hour average)	0.04 ppm (one-day average) 0.1 ppm (one-hour average)
Carbon monoxide (CO)	9 ppm (8-hour average) 35 ppm (one-hour average)	10 ppm (one-day average) 20 ppm (8-hour average)
Photochemical oxidant (Ox)	0.08 ppm (one-hour average) of ozone (O_3)	0.06 ppm (one-hour average)
Suspended particulate matter (SPM)	0.26 mg/m^3 (24 hour average) of suspended particulates (*TSP)	0.1 mg/m^3 (one-day average of hourly values) 0.2 mg/m^3 (one-day average)

Note: * Total suspended particles
Source: General Report on Air Pollution Control (JICA, 1992)

d. Water Pollution Measures and ISW

Water pollution in Chile is mainly caused by waste water from mining, fishery product process industries and domestic waste water.

Although air pollution problems in the Metropolitan Region draw attention as a social problem, water pollution problems are rather intangible to urban citizens. Under such circumstances, water pollution prevention measures in the Region are delayed and as for industrial waste water, it is reported that only 19 factories out of 894 major factories have some sort of waste water treatment facilities.

On the other hand, in view of the fact that vegetables grown in the Maipo river basin are not edible raw because of irrigation water contamination by domestic waste water, it is anticipated that contamination of irrigation water and agricultural land by heavy metals included in the industrial waste water is worsening day by day. This soil contamination problem by heavy metal, unlike biological contamination of domestic waste water, has crucial limitations to remedies after heavy metal related problems are tangible or prominent. The most serious consideration and measures should be given to this matter. Although the status-quo of soil contamination should be judged by

constant laboratorial analyses (for sufficient samples) of water and soil, the following issues might be involved regarding water pollution problems and countermeasures in the Region:

i. Under the circumstances, domestic and industrial waste water is discharged into rivers through sewerage system without any treatment. However, as mentioned above, problems (except irrigation water contamination problems) are not tangible nor prominent because of abundant and rapid flow of the rivers and proximity to the open sea. In spite of it, it is seriously envisaged that contamination of agricultural land and the sea bed (which forms fishery reserves) by industrial waste water is gradually and steadily growing.

ii. In accordance with the present situation that problems are not tangible, most factories seem to be indifferent to treatment of their industrial waste water and few factories have voluntarily equipped waste water treatment facilities, rapid and substantial improvement in industrial waste water control/management may not be expected. However, based on the nation-wide awareness on water pollution problems, industrial waste water regulations on a national level are currently under preparation. It is expected that measures for industrial waste water in the Region will gradually be implemented accompanied with this nation-wide movement.

iii. According to the SOFOFA, it is planned to formulate a system of sewage treatment that factories should equip preliminary treatment to eliminate heavy metals and adjust pH of waste water, and municipal sewage treatment plants should treat both effluent waste water after factories' preliminary treatment and ordinary municipal sewage together. Water pollution prevention measures are also supposed to be proceeded with in this plan. In consequence, huge amounts of inorganic sludge (from factories) and organic sludge (from municipal sewage treatment plants) will be generated. Inorganic sludge (generated from factories' treatment facilities) especially might turn out to be ISW containing high concentration of hazardous substances.

e. ISWM as an Environmental Policy

As seen above, in parallel with enforcement of anti- air/water pollution measures, generation of sludge and dust containing hazardous substances will be estimated to increase rapidly. It is therefore generally recommended and put into practice that

distinctive controls and treatments for "hazardous waste and liquid waste" and "non-hazardous waste" are to be established. Control and disposal system for dust and sludge generated in relation to anti- air pollution measures will be sought along this orientation. As for the sludge generated in relation to anti- water pollution measures, the plan mentioned above (preliminary treatment at factories and municipal sewage treatment plants) needs to examine its objectives and contents, namely:

- For what purpose factories' preliminary treatment is carried out;
- How long does it take to construct municipal sewage treatment plants and to initiate secondary treatment at those plants and what kind of problems occur before the realization of secondary sewage treatment;
- What are hazardous substances in relation to the problems anticipated before initiation of secondary sewage treatment, and whether or not those anticipated problems will have to be solved only by factories' preliminary treatment.

Meanwhile today's problems regarding water pollution are such as pathogenic contamination of vegetables and fishery products due to untreated municipal waste water discharge. Foreseen problems incurred by industrial waste water are so serious that hazardous substances in the industrial waste water may contaminate agricultural lands and the sea area (especially sea bed) and be gradually concentrated due to the bio-magnification of hazardous substances through the food chain and jeopardize human health.

Although quite a few hazardous solid wastes are listed , not many substances (which have the high potentiality, in view of their quantity and quality of hazardousness, of creating incurable health damages by bio-magnification through food chain) are generated and discharged from the Region's factories. Therefore, if controls of these substances and control and disposal of waste water related are fully performed, major problems are expected to be mitigated for the time being. It could significantly function as countermeasures for the longer time period before the planned sewage treatment system is established.

Control of hazardous substances in factories is generally carried out in three stages:

- hazardous substances control,
- waste water treatment and
- hazardous solid waste control.

However, none of these three controls are satisfactorily performed in the Metropolitan Region.

Meanwhile, there must be mainly two alternative approaches for the choice of Hazardous Industrial SWM, namely:

i. End of Pipe (EOP) Treatment

"Hazardous Industrial SWM" should be designed (allocated and assigned) as control and disposal of hazardous sludge, which is generated as an outcome of "waste water treatment (in-factory preliminary treatment)".

ii. Cleaner Production (CP)

"Control of hazardous substances at the stage prior to the generation of hazardous waste water" by enforcing thorough in-factory "hazardous substances control" and "production control". As a consequence of the latter approach, necessities for "Hazardous Industrial SWM" might be nullified or significantly reduced.

Choice of Industrial SWM with major emphasis on either approaches might be judged through the following (three) examinations:

- Which solid waste especially contains such hazardous substances that introduce incurable health damage by bio-magnification (through food chain) by way of agricultural land contamination and so on.
- In which of the above three stages, control of such substances is possible. In practice, whether or not the control is possible in the first stage (hazardous substances control). If not, whether or not "control of production process" can significantly reduce the substances' leakage into waste water.
- In cases when substances' leakage into waste water is inevitable, what kind of waste water control could limit the generation of hazardous sludge to minimal. Whether or not cost burden will be reduced.

It is essentially important that industrial SWM in the Metropolitan Region should be examined and analyzed fully keeping in mind the correlations with air pollution prevention measures, water pollution prevention measures and hazardous substances control.

f. Environmental Impact Study (Estudio de Impacto Ambiental (EIA))

fa. Scope of the EIA

The regulations for EIA requirements are specified in the new Environmental Act. They have not yet become fully operative, because certain specifications necessary for the proper application of the act are still under preparation. This means that applying the new system is still voluntary. At present it is assumed that the necessary regulations for the EIA system to be fully operative will be ready by the end of 1995.

The overall intention of the EIA instrument is to facilitate the paperwork related to both environmental and other permits to be obtained as necessary prerequisites for establishing certain activities, first and foremost industrial production.

Another achievement by the EIA instrument is the publication of intended activities, giving the public an opportunity to express its opinion.

fb. Content of the New EIA Regulations

The rank of activities covered by the new act is very extensive as specified in article 10. It ranges from small power plants of more than 3 MW, nuclear reactors, urban development plans, practically all production activities on industrial level, pipelines, and extensive application of chemical substances near urban areas, to environmental installations (sewage treatment plants, landfills etc.).

There is, however, one important limitation to the application of the very extensive EIA: A study only has to be made if the activities to be established are especially risky, could have significant adverse effects, are located close to vulnerable areas (for example densely populated areas), etc. This is specified in article 11.

Activities covered by article 10 but not by article 11 will have to present an Environmental Impact Declaration (Declaracion de Impacto Ambiental (DIA)) according to article 18 of the act. The DIA is a legally binding statement regarding the anticipated environmental conduct of the activity.

The overall authority in relation to EIAs and DIAs is the COREMA. It is not, however, assumed to carry the sole responsibility of the administrative treatment of the received EIAs and DIAs. COREMA's role could more be regarded as a coordinating body for the proper synthesis of all the necessary permits into one single document.

(Under very specific conditions, namely if the activity in question is related to more

than one region in Chile, the CONAMA may be the coordinating body instead of the regional COREMA.)

fba. Structure and Scope of Work of the COREMAs

COREMA has a double structure: It will both relate to the CONAMA in Santiago and be the local environmental administrative body represented by locally elected politicians and local representatives of ministries.

The "**political**" COREMA (the CONAMA board) is chaired by the regional Governor (Intendente) and has the following members (article 81):

- the leaders (gobernadores) of the provinces in the region;
- the regional secretaries of the ministries specified in article 71 (amongst others: Economy, Public Works, Agriculture, Health, Mining, Transport and telecommunication); in general they will be represented by the Ministerial Regional Secretary (Secretaria Regional de los Ministerios (SEREMI)) established in each region;
- four members elected by and from the local Councils (el respectivo Consejo);
- the director of COREMA who will also be the secretary of this group.

The "**administrative**" COREMA is represented by its director who is also a member of the board of directors of CONAMA (article 80). He is supported by a few professionals in his daily work. (It might be more correct to name this body "the regional branch of CONAMA").

The practical assessment of the EIAs and DIAs is, however, carried out by a Technical Committee (Comité Técnico) which is composed of the regional directors of the public services related to the relevant environmental or technical issues. The director of COREMA will be the chairman of this committee (article 81).

Besides, the work of the administration will be supported by a regionally established Consultative Council (Consejo Consultivo Regional del Medio Ambiente) who will represent science, NGOs, enterprises, workers, and the Governor (Intendente). The functioning of this council will be specified in a regulation.

The Technical Committee and the COREMA administration will assess the EIAs and DIAs received and prepare a recommendation for the COREMA board which makes the final decision. The decision on whether a DIA is sufficient in a current case or an EIA should be acquired rests, however, on the Technical Committee and the

COREMA administration.

fbb. Public Participation

The environmental act states (in article 26 and 27) that the content of the EIAs must be published in the Gazette (Diario Oficial) and in a relevant local newspaper. The information (advertisement) should contain at least:

- name(s) of the legal person(s) responsible for the project;
- position of the intended construction site;
- information regarding the character of the project;
- estimated sum of money to be invested;
- main environmental impacts and proposed mitigation measures.

The public will have the opportunity to familiarize itself with the content of the EIAs by addressing COREMA. However, information from parts of the EIA deserving confidentiality for reasons of competition will not be made available to the public (article 28).

The public may comment on the EIAs within a certain period. The public comments must be considered in the COREMA assessment.

Regarding the DIAs the procedure is much simpler. On first weekday in each month the received DIAs from the previous period must be presented in the Gazette (Diario Oficial) and in a relevant local newspaper. The information (advertisement) should contain at least:

- name(s) of the legal person(s) responsible for the project;
- position of the intended construction site;
- information regarding the character of the project.

No public commenting period is foreseen regarding DIAs.

fbc. Time-limit for COREMAs Work

The act sets very distinct and very strict time-limits for COREMAs reaction on the EIA or DIA received:

Within 120 days COREMA has to have obtained all comments and wishes from relevant bodies on the EIA and express its opinion (article 15). If the opinion is positive it must be accompanied by the proper environmental permits.

The applicant may, however, start construction work and production before the EIA is approved only if he takes out a proper insurance.

In case a public institution has not made its comments within the above period, further 30 days may be allowed for that. If no comments are received within this period it is assumed to be an approval.

Insufficient study quality may require further information from the applicant, but this will not automatically extend the 120 days period (article 16).

If it is needed for the proper treatment of (for example) new information COREMA may, however, extend the 120 days by 60 days (article 16), but this can take place only once.

If COREMA does not comment on the EIA within the period(s) mentioned above, it is considered approved.

For DIAs the procedure is much the same, only that the time limits are shorter. COREMA has only 60 days to react, with a possibility of extension in lack of public authorities' reaction of 30 days (article 18).

In case of lack of information there are the same options for DIAs of a single extension of the time-limit of 30 days (article 19).

fbd. Time-Limits for Public Participation

Within the 120 days period mentioned above the public should have possibilities of expressing their opinion as mentioned in b. above.

COREMA must publish the content of the EIA as mentioned under b. within 10 day of reception of the study (article 27).

The public must then forward their observations to COREMA within 60 days from the public announcement (article 29). COREMA must consider these observations in its final decision regarding the Study. COREMA must inform those who have made observations about the result of COREMA's considerations.

fbe. Possibilities of Complaint

The applicant's possibilities of complaints against a decision made by CONAMA or COREMA (for example unacceptable conditions or denial of an EIA approval) are

described in article 20:

The addressee of a complaint will depend on the category of decision: For an EIA it will be the Board of Directors of CONAMA (Consejo Directivo, which according to article 71 means almost all the ministers of the government), and for a DIA it will be the Managing Director of CONAMA (Director Educativo, article 75).

The time-limit for a complaint is 30 days from notification.

The appeal authority must make a decision within a period of 60 days.

Within a further 30 day period the applicant may bring the decision of the appeal authority before a skilled judge.

The public also have the option for complaints, for example if they do not see their observations sufficiently considered. This is specified in article 29:

A complaint must be filed within 15 days to "higher authority" (la iterated superior) which is not specified.

This authority must reach a decision within a period of 15 days.

There are no provisions for filing a second complaint as is the case for the applicant.

The public complaint does not delay the rights of the applicant to construct or produce if he has been so authorized.

fc. *Evaluation of the EIA/DIA Regulation*

In general the new regulations with their aim of coordinating authorities' treatment of environmental applications and anything related to this are considered very enterprise-friendly. According to information received from administrative staff of different bodies such coordination is also much needed as the present system is very complicated and lacks communication among the various administrative bodies.

It is, however, worth considering if the enterprise-friendliness is not carried a little too far. The act settles that if the authorities do not react within a certain time limit, the EIAs and DIAs should be considered approved. This is a most unusual administrative practice. Although it must be acknowledged that certain restrictions may be set on the time-consumption of public authorities in dealing with environmental applications and alike, automatic approvals in case of non-reaction may not be the most proper way for

such highly complicated and environmentally sensitive matters.

It should be considered to replace these very strict time limits for any EIA independent of size and degree of complexity by a preliminary evaluation of any specific EIA when received. Based on this preliminary evaluation, CONAMA/COREMA should make a statement regarding assumed time needed for the treatment of the documents, and CONAMA/COREMA would then have to react with this time limit.

It is also doubtful whether the time applied in the act for public participation in EIAs will be sufficient. Besides, the legislation does not allow for public hearings regarding highly complicated projects which may be impossible for the layman to apprehend in written form. It is recommended that provisions be made to cope with these problems by allowing more time for the administrative treatment and for public hearings in case of complicated projects.

The final comment has to do with the unspecified borderline between EIAs and DIAs. It is recognized that more projects will only need a DIA instead of an EIA as environmental standards etc. develop in Chile. It is, however, necessary to specify in the legislation the specific criteria that determine the procedure (EIA or DIA) to be cleared by all activities. In order to avoid any doubts both in trade and industry and in the public, such criteria should be specified. In doing so, specific Chilean conditions must be taken into consideration. Therefore, no specific recommendation is made.

H.3.2 Administration and Organization

a. Organizations Related to Environmental Policy

Thirteen Regions constitute the Republic, divided into Provinces and Municipalities (Comunas), the smallest unit.

The National Executive Power, under the responsibility of the President, is distributed among 13 Ministries and 2 General Secretaries with the same status. Each Ministry plus the Republic General Secretary maintain a representative (Ministerial Regional Secretary) in each Region, and the 14 representatives compose the Ministerial Regional Secretary of that Region (SEREMI/Region). Each Region has an Intendente that is the chairman of the SEREMI, and together they constitute the Regional Government.

The Provincial Government has only coordinating functions.

The legal acts of a national level are: a Law originated in Congress (Legislative Power), a Decree-Law by the President, a Supreme Decree by a Ministry (also signed by the President), and Resolutions by the Ministries. At the Regional level, Resolutions should be promulgated by a Ministry or by a Regional Body. At the Municipal level, the highest legal acts are ordinances, promulgated by the mayor (Alcalde) or by a Regional Body.

Historically, each Ministry regulates its own specific activities that could have an impact on the environment or that have the purpose of protecting it. The Ministry of Health (MS: Ministerio de Salud) is responsible for all matters related to health and environmental aspects. Most recently, the National Environmental Committee (CONAMA: *Comision Nacional de Medio Ambiente*) was created under the Ministry of National Properties (Ministerio de Bienes Nacionales). Now CONAMA has been transferred to the General Secretary of the Presidency (Secretaria Nacional de la Presidencia). Composed by representatives of Ministries and other bodies, CONAMA should be the supreme council to dictate principles and policies for the environment. In the Metropolitan Area of Santiago and further in each Region, a Comision Regional de Medio Ambiente (COREMA) constitutes a bridge between it and local environmental bodies, and promotes and supplies needs to their activities. CONAMA shall evaluate or coordinate the Environmental Impact Assessment enforced by Law Nº 19.300- General Basis for the Environment.

Ministerio de Salud (MS) is the principal executive and normative body throughout a system of 13 regional components (SEREMI) of national health services (Servicios Nacionales de Salud), and the regulation departments (Depto. de Programas Ambientales). The Ministry manages a central fund (FONASA: Fondo Nacional de Salud) whose money comes from fines and services done by the executive regional and national components of the referred system. Usually, the fund supplies extra-budget needs of the same generator bodies.

SEREMI/SANTIAGO includes 4 health services and the Metropolitan Health Service for the Environment (SESMA: Servicio Metropolitano de Salud del Ambiente) which, in 1993, started the control of industrial solid waste.

The Public Works Ministry (MOP: Ministerio de Obras Publicas) is responsible for the protection and maintenance of both natural and constructed water systems, operating directly or through contractors according to Law Nº 3133/16. (Further complemented by decrees and resolutions). Its Sanitary Services Superintendencia (SSS: Superintendencia de Servicios Sanitarios) controls the industrial liquid effluents (RILES-Residuos Industriales Líquidos), including those from the mining industry.

The Mining Ministry (Ministerio de Mineria) regulates their specific environmental

problems often based on MS and MOP directives.

The Transportation and Telecommunications Ministry (Ministerio de Transportes y Telecomunicaciones) regulates the transportation of dangerous goods, including hazardous waste, and other materials, waste included, as well as vehicle requirements (D.S Nº 75/87). The sanitary aspects of transportation are also controlled by MS, and the Municipal collection of refuse is also regulated by the Ministry of Internal Affairs (Ministerio del Interior) covering municipal actions.

Ministerio del Interior, as coordinator of municipal activities, regulates the collection and disposal of solid waste and other municipal sanitary obligations (D.S Nº4.740/47), as well as authorizing to charge for those services (D.S Nº3063/79). The Constitutional Law of Municipalities (Nº 18695) decided that public cleansing and waste collection are municipal attributions.

The Ministry of Housing and Urban Development (Ministerio de Vivienda y Urbanismo) provides directives and parameters for the municipal regulations of land occupations (D.S Nº47). The Regulatory Metropolitan Plan of Santiago (Plan Regulador Metropolitano de Santiago), published by the Metropolitan Regional Government (Gobierno Regional Metropolitano-Resolución Nº20/94) delimits the urban area and its allowed occupation; establishes the waste disposal as part of the Metropolitan Sanitary Infrastructure; considers transfer stations, recycling plants and incinerators as industries allowed inside the urban area, but sanitary landfills and any final disposal site for industrial solid waste must be outside; the ISW must be "inert", and the pre-treatment may be allowed within the generators' area.

The Ministry of Agriculture (Ministerio de Agricultura) must approve or reject the use of an agricultural land for waste disposal; the land is classified into 8 categories according to its agricultural aptitude; sanitary landfills are forbidden in categories 1 to 3. This Ministry controls soil/water contamination by residues that could damage cultures and/or livestock.

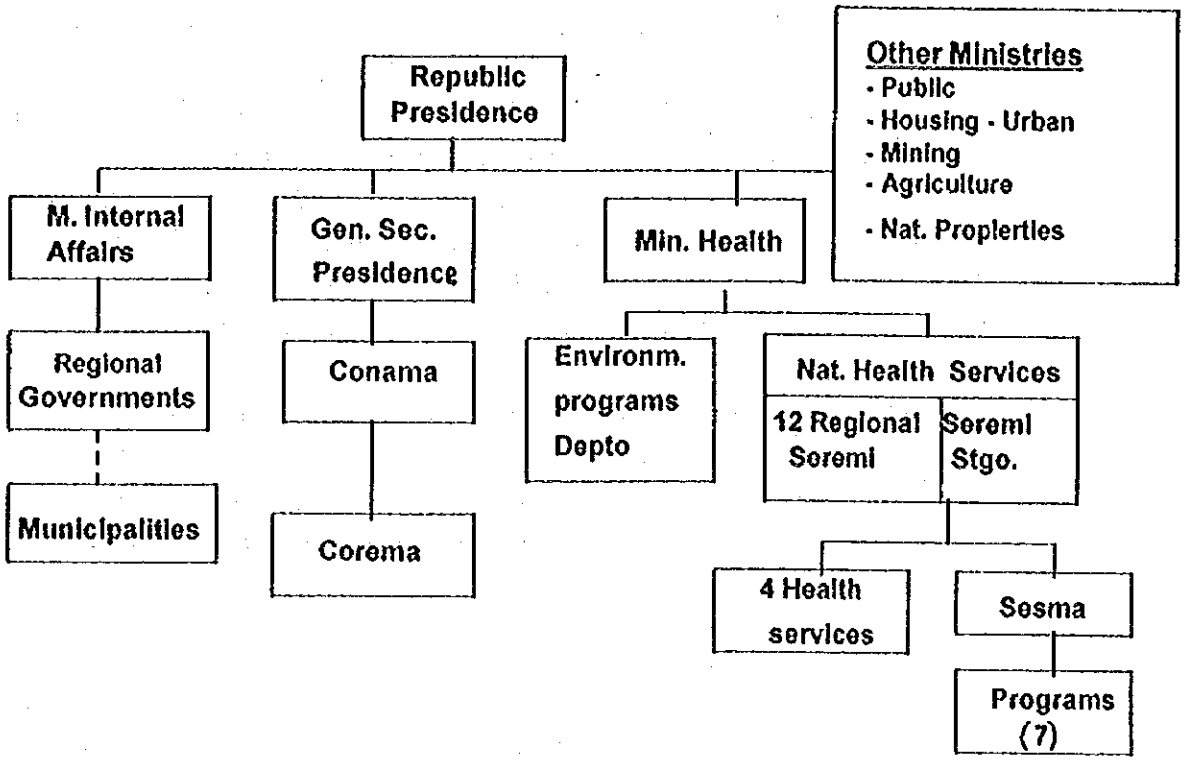

Figure H.3.2a National and Regional Organizations which Regulate Environmental Matters

b. Organizations Related to Industrial and Medical SWM

Many other governmental and local bodies are presently involved in environmental administration. Presently, the most important ones are the Health Services (Servicios de Salud (SS)) which belong to the Ministry of Health (Ministerio de Salud) under an umbrella organization called National System of Health Services (Servicio Nacional de Servicios de Salud (SNSS)). There is one SS in each region. The SS have a medical and an environmental branch and are usually located in the main hospital of the region. The environmental branch of the SS is presently in charge of issuing environmental authorizations.

In the metropolitan area the environmental branch of the SS is named separately and is known as the Metropolitan Health Service for the Environment (Servicio de Salud Metropolitano del Ambiente (SESMA)). SESMA has under its jurisdiction several offices in charge of different environmental issues, for example one for industrial

sewage (RILES), one for domestic waste, and one for air emissions and industrial solid waste (Programa de Control de Emisiones de Fuentes Fijas (PROCEFF).

A couple of studies have recently been conducted regarding non-hazardous and hazardous (including hospital) waste by Electrowatt and Dames & Moore. The studies were initiated by the Special Commission for Pollution Control in the Metropolitan Region (Comision Especial de Descontaminacion de la Region Metropolitana (CEDRM)) which was the forerunner of the present COREMA. One of the results of this study is that SESMA has through PROCEFF initiated a thoroughly developed control system for industrial waste from manufacturing industries. This system includes a registration of the major waste generation industries.

SESMA is a very dynamic body, working in function of programs supported by a small permanent structure, composed by four technical departments: Administrative, Legal, Auditing and Technical; the latter department manages the program, advised by some specialists (two at this moment). Each program has a coordinator, a technical team and a small Administrative Staff.

SESMA is now working on seven programs:

- Basic sanitation: drinking water, sewage, industrial liquid effluent, domestic solid waste, domestic pesticides, vectors, public areas control, and irrigation channels control (cholera);
- Air monitoring and control of the atmosphere;
- Health Education;
- Dietetics;
- Occupational health;
- Zoonosis;
- Stationary Emission Sources Control (PROCEFF): air emission and ISW.

SESMA and the Health Services attain, by means of issuing recommendations to their own units, some degree of control over the waste management of the residues resulting from medical and paramedical activities.

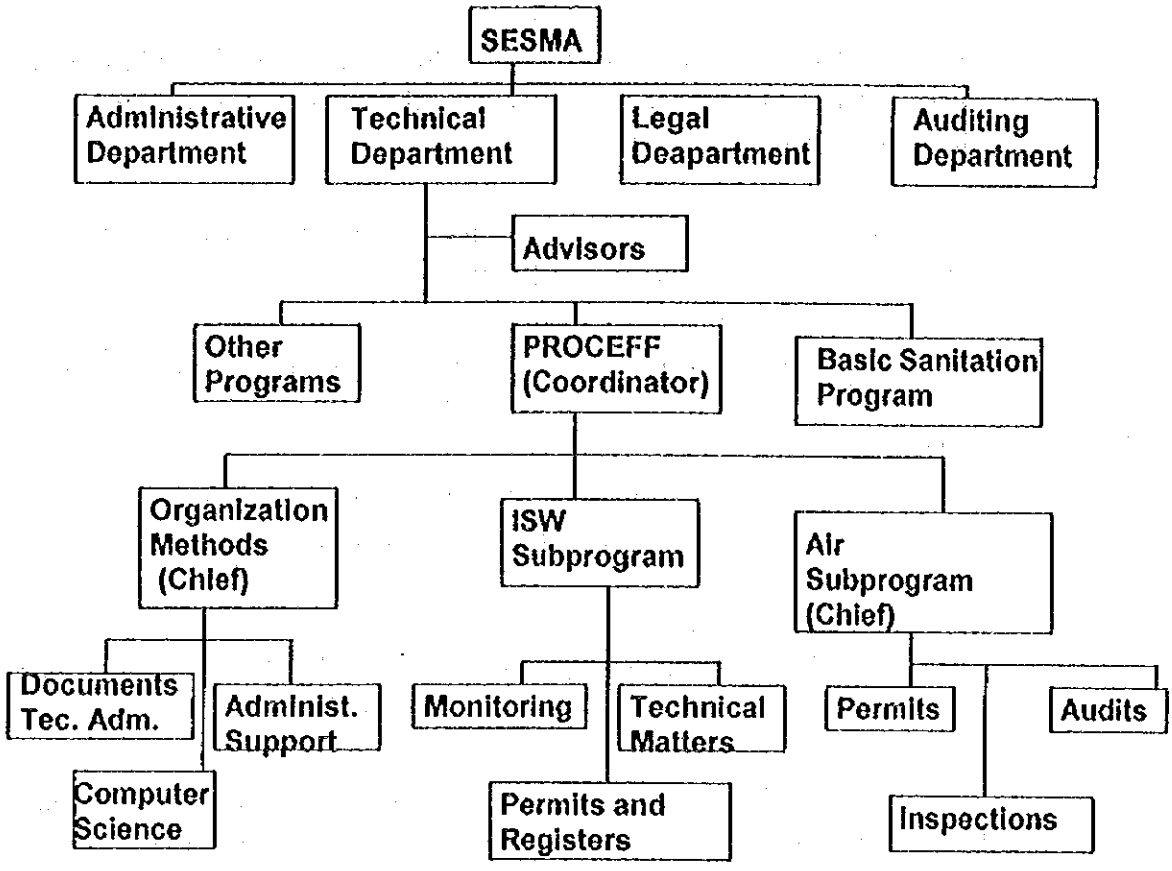

Figure H.3.2b SESMA Organization Diagram

H.3.3 Legal System

a. Legislation and Enforcement

aa. Basic Environmental Act and CONAMA

The environmental legislation in the Republic of Chile is at its very beginning. An environmental act was passed through Parliament in 1994 and was published in the Gazette (Diario Oficial) on the 9th of March 1994. It has not yet become fully operative, because certain specifications necessary for the proper application of the act are still under preparation.

Also Chile has so far not institutionalized a separate Ministry of Environment. Environmental protection issues are related to a National Commission for Environmental Protection (Comision Nacional del Medio Ambiente (CONAMA)) which works, since 1995, with direct reference to the President's General Secretariat (Ministerio Secretaría General de la Presidencia). Subordinate to CONAMA work 13

Regional Commissions for Environmental Protection (Comisiones Regionales del Medio Ambiente (COREMA)), one in each of the 12 regions of Chile and one in the Metropolitan Region.

The above-mentioned act is known as the "Environment Basic Law" (Ley de Bases del Medio Ambiente) and the law is number 19,300.

The headings of the act's chapters give a good impression of its aim and scope:

Chapter I:	General Dispositions.
Chapter II:	Instruments for Environmental Management.
Chapter III:	Responsibility for Environmental Damages.
Chapter IV:	Fines.
Chapter V:	Environmental Protection Fund.
Chapter VI (Final):	National Commission for the Environment (Comision Nacional del Medio Ambiente (CONAMA)).

The Environment Basic Law act is in its form and content to a large extend directed towards regulating enterprises. Its main part is chapter II (45 articles out of a total of 92). The essential part of this chapter is applied to defining the conditions for and the content of Environmental Impact Studies (Estudios de Impacto Ambiental (EIA)) and of Environmental Impact Statements (Declaraciones de Impacto Ambiental (DIA)). However, in order that the system of EIA becomes obligatory, establishment of the regulation which regulates it is necessary.

Except for the instrument for enterprise evaluation and regulation in chapter II, chapter III concentrates on the legal steps to be taken in case of non-conformation with the stated conditions and standards. This is done in great detail and includes two interesting aspects:

- First, it is stated in article 56 that the sanction for non-compliance may reach from reproaches in cases of mild violation over fines in more severe cases to temporary or irrevocable closing in the worst cases.
- Second, it is stated in article 58 that the judge should in his decision consider four different issues:
  - The severity of the violation;
  - The recurrence of the violation;
  - The economic capability of the violator; and
  - The general compliance with the obligations settled in the EIA of DIA.

Chapter IV specifies further on fines, chapter V establishes an Environmental Protection Fund to be financed both from the Finance Act and from voluntary contributions and contributions according to other act (but obviously not from the above-mentioned fines), and chapter VI (Final) establishes the CONAMA and the COREMAs.

CONAMA has in general functions related to it being an administrative body responsible for the formulation of the overall environmental policy of Chile. It will, amongst others, be in charge of making suggestions to the President regarding environmental policy, maintaining a public environmental information system, establishing regulations and standards related to EIA and DIA, and supporting international relations regarding environmental issues.

The COREMAs have as their primary duty to coordinate the evaluation of the EIAs and DIAs which are conveyed to these regional offices. CONAMA will only be directly involved in EIAs and DIAs if they are related to enterprises with activities in more than one region.

Chapter VI settles the total staffing of CONAMA and of the 13 COREMAs to be 62 persons. It should, however, be mentioned that much work will be done for the COREMAs by employees from other administrative bodies.

Article 10 of Chapter II indicates that all projects for treatment or disposal of ISW must undergo an EIA.

ab. Act 5081/93 from SESMA

This act establishes a declaration and monitoring system for ISW generated in the MR. The act indicates that all enterprises located in the MR and which generate and receive ISW must submit to SESMA, within the first 10 working days of each calendar month, a consolidated statement (Monthly Consolidates Statement of Generator/Receiver) summarizing the amounts and types of wastes generated or received, depending on the case, during the previous calendar month.

The act also establishes that all movements of ISW must be accompanied by the so called Declaration Statement from the place of generation until final destination.

ac. Law 3.133/16 and its Regulation from Decree 351/92

Decree 351, dated on November 26th 1992 by the President of the Republic, and based on Law 3.133/16 and other legal acts, defines the concepts and the industrial activities

affected (identified by CIIU code), whose effluents may not be discharged to any aquatic environment, whether natural or artificial, below or above ground level, without authorization from the President of the Republic to be issued through a decree by the MOP after appropriate report from the SSS. Such authorization always requires that the effluent be harmless to the water for both irrigation and drinking purposes.

The requirement is extended to discharges into the sewerage system that may damage the collection or treatment systems, or that infringe the quality standards in force.

The SW resulting from liquid effluents' treatment, as well as any other industrial waste, may not be discharged into natural or artificial waterways nor to the sewerage, and may not be disposed in such manner that the ground water table may be contaminated. These wastes may only be stored in places authorized by the Health Service and permission to discharge the effluents (mentioned before) is subject to the decision of the Sanitary Authority which approves the final disposal system for SW.

This legal document defines the penalties to be applied in cases of infringement. Given that the SSS has no legal competence for applying such penalties, it must inform the corresponding Municipality and Health Service about the infringement. The SSS may also request to the Justice Court of Law (Tribunal de Justicia) that it applies the pertinent legal actions by means of its own procedure.

The treatment system for the effluent, together with the final disposal system for the subsequent SW, must be submitted through the Provincial Governor in order to obtain approval from the President of the Republic, which will be realized by a MOP's decree after approval by SSS.

New establishments must make a joint request for the necessary permit. The solicitant will make its request public, including data for the project, so that persons who believe themselves affected by the project may voice their opposition (which will be answered by the SSS and may leadto a possible revision of the project).

ad. *Sanitary Code*

The Sanitary Code contains several articles related to ISWM. Among these articles, it is important to mention the one indicating that any project related to the construction of facilities intended for the discharge, treatment or disposal of industrial and mining waste (regardless of the type) must be approved by the Health Service (Servicio de Salud). Furthermore, the Health Service must issue the pertinent permits prior to the start of any construction work.

ae. Supreme Decree 745, from 1992, by the Ministry of Health

This decree contains the regulations for Basic Sanitary and Environmental Conditions at the Workplace. Title II, in its Paragraph III, refers to industrial waste disposal. Among other aspects, this article establishes that the on-site storage, treatment and disposal of waste containing some of the substances listed (nitrate and nitrite among others) must obtain the authorization of the sanitary body. The same article defines both "industrial waste" and "hazardous waste".

b. ISW Control

SESMA has through PROCEFF initiated a thoroughly developed control system for industrial waste from manufacturing industries. This system includes a registration of the major waste generation industries. The waste from these industries is then controlled via a declaration system on which the waste generating plant informs PROCEFF about the monthly amounts of waste, the waste transporter and the final destination of the waste. This document will accompany the waste during transportation until it reaches the final destination. The receiver will then confirm the reception towards the generator and PROCEFF.

c. Permit for ISWM Facilities

Law 19.300, under the name Basic Environmental Law ("Ley de Bases del Medio Ambiente"), indicates in article 10 (sections "ñ" and "o") that all projects related with the following activities must clear the EIA system.

- production, storage, transportation, disposal and reutilization of toxic, radioactive, flammable, corrosive and reactive substances (section "ñ");
- environmental sanitation projects, such as sewerage system, water or domestic waste treatment plants, sanitary landfills, submarine works, treatment systems, or liquid/solid industrial waste disposal (section "o").

The CONAMA-RM will then examine the EIA submitted by the promoter and announce its decision before the next 120 days. The acceptance of the project will then be accompanied by the environmental permits or notification that the government bodies are able to issue at the time. On the other hand, if the project is rejected, the promoter may submit a new EIA according to the commented requirements specified by CONAMA-RM.

The following permits or notification will be necessary for an ISW storage, treatment or final disposal plant:

- Change in land use issued by the Agriculture and Livestock Service (Servicio Agrícola y Ganadero, SAG), which falls under the Ministry of Agriculture. Any activity falling outside the urban area requires a permit for the change in land use issued by SAG. Land is classified into Categories I through VIII, with types IV through VIII (those with low or zero agricultural aptitude) being able to receive authorization for the siting of SW treatment or final disposal facilities. If the facility falls inside the urban area it must be located in the designated zones for industrial use (according to the Regulatory Plan) in which these activities are accepted. If this is not the case, an explicit request is necessary. Sanitary landfills for municipal and industrial waste must remain outside the urban area.
- Approval by SESMA, under the Ministry of Health;
- Patent obtained at the corresponding municipality where the activities are to be developed. In case of treatment plant or sanitary landfill the required patent is an industrial one;
- Permit from the municipality for the construction of civil works for the facility (access, fencing, offices, potable water supply, etc.); and
- Authorization by SESMA for beginning of activities.

H.3.4 Evaluation of the Present Industrial SWM

In evaluating the present control and treatment/disposal of industrial solid waste, its on-going actual state should be first of all identified and understood. Although data and information with regard to actual conditions of control and treatment/disposal of industrial solid waste are available such as, the Dames & Moore's study for building systems for the declaration and data compiled by PROCEFF through the declaration system, and currently carried out EWI's RISNOR study for "non-hazardous" industrial solid waste, however, the actual conditions of industrial solid waste in the Metropolitan Region is only partially revealed and identified in the field of "non-hazardous" industrial solid waste.

This Study, in view of such present situation, will focus mainly on the investigation of actual conditions of "hazardous waste" but will also provide a complementary investigation for "non-hazardous". It is expected that considerable analysis for the status-quo of industrial solid waste in the Metropolitan Region will be realized until about June 1995.

On the other hand, the stance of IW in the MR and its structural relationship with issues and problems are foreseen through the assessment of previous studies. This structural relationship will have to be incorporated and developed for the examination *of orientation of further studies.*

a. *Basic Information Regarding the Status-quo*

Through this Study, the following information with regard to the status-quo of *industrial solid waste in the Metropolitan Region was obtained:*

aa. Present Situation of Municipal SWM and ISW Disposal

Currently, municipal solid waste from the Metropolitan Region is disposed of at 3 sanitary landfill sites where the technological standards of landfill are equivalent to that of international levels. The comparatively small amount of precipitation (i.e. 300 mm per year) in the Metropolitan Region enables leachate treatment by circulation. In view of these aspects, problems with regard to municipal solid waste disposal are not foreseen if this standard of municipal landfill operation is maintained. At present, a considerable amount of industrial solid waste is brought into these municipal landfill sites. As long as these industrial solid waste brought into are "non-hazardous waste", technological problems shall not be foreseen. However, if industrial solid waste brought into consists of "hazardous wastes", critical problems with regard to management of ex-landfill sites in future shall to remain.

ab. Illegal Dumping of ISW

Although most municipal solid waste and a majority of industrial solid waste are securely treated and disposed in sanitary landfill sites, about 100 illegal dumping sites of industrial solid waste obviously exist, including near where present municipal landfill sites are located, which consequently invites underground-water contamination and deterioration of surrounding living environments, as well as a prevalence of vicious prejudice towards industries.

ac. Information of the Status-quo of ISW Generation

As for the status-quo of industrial solid waste generation, when the Study Team compiled data of 264 factories (which EWI's accumulated in his RISNOR investigation), estimated generation rate of: 10,047 ton/month of "non-hazardous waste", 186 ton/month of "hazardous waste", and 161 ton/month of "liquid waste" was calculated. Meanwhile EWI's RISNOR investigation has not produced the final report,

the Study Team planned to estimate annual generation of non-hazardous, hazardous waste and liquid waste by extrapolating industry-wise employees (data from INE for industries of 10 or more employees), it derived estimation of annual generation of 686,000 ton/year, 11,000 ton/year, and 12,000 ton/year for non-hazardous, hazardous wastes and liquid waste for industries of 10 or more employees respectively. While investigation and estimation of status-quo of industrial waste generation will be further pursued in the Team's 2nd Work in Chile and which will have to be materialized for the analysis of present and future trends of industrial waste generation.

ad. Scarcity of Dust, Sludge, LW Generated

EWI's RISNOR study identified generation of "dust and ash" as little as 12 ton/month with a marginal amount of dust. As well as little generation of "sludge" and "liquid waste" are identified as 13 ton/month and 161 ton/month respectively. Which implies that a majority of "dust", "sludge" and "liquid waste" are re-utilized and/or discharged into the water systems.

The factory surveys conducted by the Team during the First Work in Chile also indicated the same results, though it is under analysis.

ae. Status-quo of ISW Disposal

Information with regard to the status-quo of industrial solid waste disposal are obtained through PROCEFF's Declaration System, EWI's RISNOR questionnaire completed, EWI's report of "Illegal Dumping" and record of waste admitted from three municipal landfill sites.

While further investigation and analyses of the status-quo of industrial solid waste disposal are planned in this Study, the present situation of industrial waste disposal is envisaged as follows from the information obtained:

i. Non-hazardous industrial solid waste, which counts for more than 90% of current industrial solid waste, are mostly brought into municipal solid waste landfill sites. Cost born for this disposal of non-hazardous solid waste may only comprise US$ 5.0 of the fees paid for landfill and some transportation cost.

ii. It is reported that a majority of illegal dumping is born from construction waste (which is beyond the scope of the Study). Since disposal of industrial solid waste brought into municipal landfill sites is cheaper, if control and supervision of illegal dumping are enforced, significant

improvement will be realized with regard to illegal dumping of industrial solid waste.

iii. On the other hand, there is only superficial understanding of "hazardous solid waste" and "liquid waste" in old small and medium factories, only a few factories pay special attention to control/disposal of industrial waste. Since the majority of "liquid waste" and "dust" are dispersed into the environment as waste water and effluent gas, generation of industrial waste is presently scarce and therefore treatment facilities and/or final disposal sites for such "hazardous solid waste" and "liquid waste" do not exist in Chile.

b. Issues and Problems Foreseen

In view of the basic information of the status-quo, mentioned previously, issues and problems with regard to industrial solid waste management are foreseen and summarized as follows:

ba. Non-Hazardous Waste

The municipal landfill sites, in which currently non-hazardous industrial solid waste are brought, are managed with reasonably high technical and hygienic standards, such as gate control, soil covering procedures, impermeable structure, recirculation of leachate etc.. Meanwhile it is also an advantage that annual precipitation in the Metropolitan Region is about 300 millimeters, as leachate treatment by recirculating enables lower cost.

Because fees for landfill ranges as low as US$ 3 to 5 per ton, illegal dumping takes place mainly for construction waste so that illegal dumping of non-hazardous industrial solid waste seems to count for little in total. However, under such circumstances it implies the following issues and problems:

i. Increase of landfill cost

Non-hazardous waste will still constitute the majority of total industrial waste generation, municipal landfill disposal sites to which these industrial non-hazardous wastes are disposed will in short complete their service life. Since future municipal landfill sites will tend to be in remote areas, suitable and economical locations like present municipal landfill sites are not reserved for the future landfill development. It is envisaged that solid waste disposal cost may

considerable be raised as a consequence.

ii. Lack of disposal sites for ISW

Furthermore in view of the PPP (Polluter Pays Principle), disposing of industrial non-hazardous solid waste into municipal landfill sites may not be allowed for long. If planning lacks consideration of consolidating industrial solid waste disposal facilities through utilization of private sectors, existing waste disposal facilities would be in the near future congested and overloaded, resulting in facilities unable to contend with the waste influx.

iii. Increase of illegal dumping

Both the disposal fee of 3 to 6 US$/ton of present municipal landfill sites and their location being near the urban area (which enables lower transportation cost) leads to less illegal dumping of ISW. In view of this, if final disposal areas are to be constructed in remote places and disposal fees are raised, it may easily lead to a rapid increase in illegal dumping.

bb. Hazardous Waste and Liquid Waste

Issues and problems in relation to non-hazardous waste are comparatively simple, as mentioned previously, thus countermeasures to be proposed may also be rather facile. However, issues and problems foreseen in "hazardous waste/liquid waste" are complicated and serious as described below.

i. Scarce generation

Both EWI's RISNOR investigation and the Team's surveys verified only small quantity of "hazardous waste" and "liquid waste" generated. However, it is understood that since standards for discharged water quality have not been enforced yet and regulations and guidelines for air pollution have just launched in Chile, majority of industries have not commenced air/water pollution protection measures. For example, a survey of the Superintendency of Sanitary Services of the Ministry of Public Works reported only 19 factories out of the surveyed 894 factories (it counts for only about 2%) has equipped some waste water treatment facilities. Under such circumstances, it is seriously anticipated that a great majority of hazardous substances are discharged into sewage and rivers as waste water, not extracted and emerged as industrial solid waste. Therefore, only 6 factories out of 264 factories (which were subject to EWI's RISNOR study) reported sludge waste.

ii. Indifference to hazardous substances

As for industrial solid waste in general, majority of hazardous substances are mainly emitted as contaminant in dust, ash, sludge or liquid waste. However, in a present situation most old small- and medium-factories are indifferent to particular movement of hazardous substances and therefore waste water, exhaust gas and industrial solid waste are equally disposed without making any distinctive segregation from other solid waste.

iii. Delay of water pollution prevention measures

As clarified above, management of "hazardous waste" and "liquid waste" are inseparable with "air pollution protection" and "water pollution protection" policies. Especially since water pollution prevention measures are delayed to facilitate in Chile, measures to control "hazardous waste" and "liquid waste" do not exist in effect and all hazardous substances are dispersed into air and water.

iv. Potential contamination

Under such circumstances, problems are mostly transfused to aquatic pollution (e.g. underground water, rivers, sea), however because of the following reasons, problems are not tangible nor eminent.

- Hazardous substances disposed at municipal landfill sites do not present prominent problems, since the quantity disposed is still small and the landfill facilities has equipped with highly waterproof and leachate recirculating suffices as its treatment.
- Hazardous substances discharged into sewage and rivers do not present evident problems yet since the rivers receiving waste (Maipo river and Mapocho river) are rich in flow and they run straight into the open sea.

On the other hand, it is reported that vegetables (such as lettuce) cultivated in those river basins are not edible uncooked, since they are contaminated with municipal sewage water. Which implies that soil contamination by heavy metals discharged from industrial sewage and consequently contamination of agricultural products are grave.

v. Increase of ISW quantity

However, it is inevitable that when air and water pollution prevention standards are put into practice in future, generation of "hazardous waste" and "liquid

waste", which is currently minimal, will rapidly increase, and eventually these issues and problems of industrial solid waste shall become apparent.

c. Keys for Solution

In order to solve the issues and problems foreseen, the following approaches may have to be considered.

ca. Identification of the Status-quo of the ISWM and Establishment of an Information Management System

The most basic principle and the first step of industrial solid waste management is to identify and understand the status-quo precisely. Fortunately, the Manifest System is already in operation by PROCEFF. Since relevant data were previously gathered by several studies (e.g. EWI's RISNOR study) and the Team's surveys will further contribute to accumulation of data, information regarding the present situation of generation, control and treatment/disposal from a significant number of factories can be obtained. Meanwhile it is expected that general prospects of industrial solid waste management in the Metropolitan Region could be seen through the Team's First Work in Chile. It shall be necessary to accumulate data to begin with the information presently obtained and through factory visit surveys by PROCEFF and reports submitted by factories. (Although a system for accumulating information of the industrial solid waste status-quo will be proposed in this Study,) Current flow of non-hazardous waste (which counts for the great majority of the industrial solid waste) into municipal landfill sites are presently identified in the Metropolitan Region. Therefore while this flow is tangible, the status-quo of total ISW flow should be confirmed.

cb. Clarification of Problem Structure in Current Disposal Practice

As for the issues and problems in the current disposal practice, which are mentioned as assumptions, it is essential to understand hydrological prospects both in underground and surface water, and future water use demand (including public water, irrigation and industrial water use in lower reaches). Then it might be possible that issues and problems should be clarified truly based upon explanatory data and that relative sectors should understand and cooperate in pursuing industrial solid waste management in the Metropolitan Region.

cc. Establishment of On-site ISWM Measures Relevant with Air/Water Pollution Prevention Regulations

As mentioned previously, in order to realize industrial solid waste management measures (especially measures regarding problematic "hazardous waste" and "liquid waste"), enforceable and operative regulations of air/water pollution prevention should be established. Simultaneously with regulations of air/water pollution prevention (which is presently planned to be legislated), industrial solid waste regulation (especially for dust, sludge and liquid waste) shall be reinforced. In its practice, keys to improve enforceability and operativity of those regulations are "explicit regulations standard", "penalties", "rights of on-the spot investigation" and "rights to require report submission".

cd. Final Disposal Site for ISW to be Secured

The majority of ISW is disposed into municipal landfill sites at present, thus reducing the economic life of landfills. In view of the quantity of industrial solid waste (which should rapidly increase in future) and wider qualitative variety of industrial solid waste generation forecasted (especially those including hazardous substances might be increasingly generated) and with regard to PPP (Polluter Pays Principle), it is recommended that exclusive disposal site(s) for industrial solid waste should be established.

Fortunately, there is little precipitation in the Metropolitan Region and it enables the operation control of sanitary landfill easier and there are a few candidate locations technically appropriate for landfill construction. However in favor of technical aspects, it is a prerequisite for attaining neighborhood consensus that reliable management of final disposal site(s) for industrial solid waste (including management of hazardous solid waste) shall be secured by regulating the following requirements:

- Specification of physical and technical land characteristics suitable for localization of final disposal facilities, structural specification, standards for operation and maintenance (including standards for environmental pollution control, as a matter of course).
- Set-up of procedures and methodologies of "Environmental Impact Assessment" in relation to final disposal sites (including method of public hearing for neighborhood and surrounding area).
- Establishment of manifest system, gate control (vehicle control and waste inspection analysis), monitoring and especially a system as a critical condition of the approval of a disposal site project that could facilitate restoration work and/or indemnity (including a reserve fund, insurance,

etc.) if contamination should occur.

- Set-up of technical and institutional guidelines for industrial solid waste final disposal sites, in order to induce practical functioning of those requirements.

ce. Formulation of Control and Disposal System for HW and LW

As previously mentioned, it is a precondition for establishing control and disposal system for "hazardous waste" and "liquid waste" that water quality regulations are put into practice. Meanwhile, if controls and disposal (such as, control of heavy metal contained dust derived after enforcement of air pollution prevention measures, in-factory process control over waste water contaminated with hazardous substances, control of hazardous chemical materials employed in production and production facilities, and control over hazardous discarded materials) are in depth enforced, it is expected that water pollution problems by waste water from factories should be significantly improved.

Therefore, factories' management of hazardous substances (i.e. control and disposal of "hazardous waste" and "liquid waste") shall be promoted in collaboration with both industries and administrative authorities.

In practice, the formulation of a system is required which enables the prevention of contamination of "hazardous waste" into disposal process of "non-hazardous waste", to prohibit discharge of "liquid waste" into sewage system and to store them separately and to treat through specialized facilities. Approaches to following issues are required for realizing this system.

- Presentation of technical guidelines (to be easily understandable) for determination, control and storage of hazardous substances, hazardous waste and liquid waste and education of factory executives and technical staff.
- Initiation of specialized treatment facilities for separately controlled and stored "hazardous waste" and "liquid waste" or utilization of the private sector for such specialized treatment business.
- Consolidation and reinforcement of regulations for water quality, hazardous waste and liquid waste (restriction and guidance in relation to hazardous solid waste management shall be a prerequisite).

At present, municipal landfill disposal functions as the main route for industrial waste disposal (for non-hazardous waste) at a cost of US$ 5 per ton and waste discharged into sewer or rivers does not bear the cost. However by all means, whether or not and

how much companies have willingness to bear the cost (at least several tens of US dollar per ton) of hazardous waste disposal, and whether or not institutional framework to invite such cooperation by companies can be formulated, are crucial issues to be solved.

cf. Organizational Framework of ISWM by both Administrative Authorities and Factories

In order to formulate the above approaches and to attain substantive outcome, reinforcement of organizational framework by both the administrative authorities and factories are indispensable, especially in technical human resource development and its expansion. Approaches by administrative authorities should pay attention to close relationship between industrial SWM measures and air/water pollution prevention measures, whereas factories should pay attention to inter-linkage of managements of air, water, solid waste, and hazardous chemical substances. Therefore, it is essentially important that functions of SESMA-PROCEFF should be reinforced by promoting cooperation with other relative administrative authorities.

Meanwhile, factories should assign technically responsible manager who could totally supervise controls of air, water, solid waste and hazardous chemical substances, and should formulate organizational framework which enables to manage those controls routinely.

In order for that, measures (such as, human resource training program intended for the formulation of those qualified personnel and/or institutional framework to oblige assignment of responsible supervisors) should be examined further.

H.4 Present Medical SWM

This chapter compiles the observations concerning the present medical solid waste management in the Metropolitan Region of Santiago.

The investigations resulted in preparation of a questionnaire survey to be carried and analyzed prior to establishment of the planning framework. The questionnaire survey completed the detailed information on the present situation.

H.4.1 Legislation

Currently, there are no specific laws or decrees with complete instructions concerning management of medical solid waste. The present legislation either faces the problems in a general way (for both internal and external handling) or covers very specific areas like inter-hospital precautions related to the HIV-virus.

A decree from 9 October 1947 specifies incineration at the place of generation (origin) as the (only) treatment method for medical solid waste. The decree further specifies the technical conditions of the incinerators to be fulfilled. The Sanitary Code ('Código Sanitario') from 1968 provides very general guidelines concerning sanitary conduct of waste management, leaving for the sanitary authorities (today, 'Servicio de Salud del Ambiente Region Metropolitana' (SESMA) in the Metropolitan Region) to dictate the precise norms and standards. Concerning medical solid waste, the Code simply declares that 'the optimum environmental conditions must be ensured through basic local sanitation activities'.

H.4.2 Existing Guidelines

There exists a guideline from the Ministry of Health ('Ministerio de Salud') concerning universal precautions regarding blood and body fluids (referred to as MINSAL 1988). This guideline addresses the safety of the hospital personnel and patients, but provides no guidelines for the external handling and the protection of the environment.

In 1990, SESMA issued a guideline concerning the basic sanitary conditions in healthcare establishments ('Saneamiento Básico en Establecimientos Asistenciales'). The guideline includes a classification of medical solid waste and it provides the following recommendations of particular interest for the waste categories included in the classification:

- *Biological waste* must be separately collected and contained at the source of generation and labeled 'Contaminated' ('Contaminado'). Biological waste must be incinerated, preferably in-situ. In case no incinerator exists at the hospital, cooling facilities must be provided and external treatment arranged for at incinerator or biological digester (understood as a burial according to special procedures).
- *Waste from medical surgery* must be handled as biological waste, but there is no demand for cooled storage.

- *Sharps* must be collected in hard receptacles to avoid puncture of soft packaging during the handling. The sharps must be sterilized (by autoclave) whereafter it may be disposed of together with the common waste (i.e. in the municipal solid waste collection).
- *Food leftovers from infectious patients* must be incinerated. Leftovers from other patients can be disposed of with the common waste.
- *Food leftovers from kitchens* can be reutilized for animal food or disposed of with the common waste.
- *Common waste* can be included in the normal municipal waste service.

In general, the guideline prescribes use of hard receptacles (with lids) lined with plastic bags. Furthermore, it is specified that collection personnel must not enter the hospital departments, but a synchronized transfer from the personnel of the departments to the collection personnel must be arranged for in the hall ways.

The guideline also prescribes the use of impermeable gloves, face mask and proper clothing by the collection personnel. Finally, the guideline stipulates that the storage facility is separated from main hospital buildings, that it has sufficient storage capacity for 3 days' waste production (the collection frequency is not defined) and that it is made hermetic closed with washable surfaces, bathroom facilities, water and sewer connections and other requirements for smooth operation and cleaning.

a. Internal Guidelines

According to the above-mentioned guideline from SESMA each hospital must provide internal guidelines (instructions) for the waste handling. Such instructions actually existed at the hospitals visited by the Team.

H.4.3 Definition and Classification of Medical Solid Waste

There exist no official national definition of medical solid waste in Chile. The aforementioned classification made by SESMA is an operational grouping oriented to provide guidelines for the actual sorting.

The study 'Estudio de Manejo de Residuos Sólidos de Establecimientos Hospitalarios en la Región Metropolitana' (Study on the Management of Solid Waste from Healthcare Establishments in the Metropolitan Region)' (hereinafter referred to as EWI's RESHOS study) prepared by Electrowatt Ingenieros Consultores (Chile) ltda. (EWI) for Comisión Especial de Descontaminación de la Región Metropolitana'

(COREMA) in July 1994 defines medical solid waste as 'waste generated in hospitals, clinics, surgeries and clinical and dental laboratories'.

The study proposes a waste classification based on the classification used by the US EPA supplemented with some waste types generated at hospitals, but which in the US are regulated via special legislation and therefore kept outside of EPA's classification.

The classification proposed by the study is:

- Biological waste
  - Cultures and stocks
  - Pathological waste
  - Blood and blood products
  - Animal waste
- Isolation waste (all wastes from infectious departments)
- Surgical waste
  - Sharps (used and unused)
  - Bandages, dressings etc.
- Food waste (from patients in non-infectious departments as well as from preparation of meals)
- Incombustible waste
- Common waste (waste from administrative tasks)
- Chemical waste
- Radioactive waste.

H.4.4 The Present Medical System

The medical system in Chile is partly privatized and it is the intention to further develop the private participation in the future. Each citizen contributes to the health system via a public health insurance automatically deducted from the salary, but additional voluntary health insurance is common. In case of a need of medical care, the citizen contacts the public health system to specify the needs and to collect a voucher for payment of the part to be financed by the public health insurance. Depending on the required medical service the citizen will have to contribute with additional payment - less in the public system and more in the private system.

The medical service in the Metropolitan Region is executed in 6 administrative districts with some degree of budgetary independence:

- Central district ('Servicio de Salud Metropolitano Central')
- North district ('Servicio de Salud Metropolitano Norte')
- East district ('Servicio de Salud Metropolitano Oriente')
- South/East district ('Servicio de Salud Metropolitano Sur/Oriente')
- South district ('Servicio de Salud Metropolitano Sur')
- West district ('Servicio de Salud Metropolitano Oeste').

Table H.4.4a presents the number of health care units and beds.

Table H.4.4a Health Care Units and Hospital Beds in Santiago Metropolitan Region, 1994

Service area	Hospitals	Hospitals belonging to institutions	Clinics	Maternity clinics	Rural health centers	Rural and urban surgeries	Total
SSMC	4	1	13	3	-	7	
SSMN	7	-	-	-	8	15	
SSMOCC	7	-	5	-	19	33	
SSMORI	10	4	24	3	-	17	
SSMS	7	-	4	-	11	26	
SSMSOR	2	-	1	-	9	19	
Units, total	37	5	47	6	47	117	259
Beds	11,598	1,340	1,381	198	-	-	14,517

H.4.5 Technical System

The description of the technical system is based on the visits carried out by the JICA Study Team accomplished by the questionnaire survey reported in Annex D.

The typical technical system at the hospitals includes the following elements:

- Sorting (classification) of the waste at the source of generation and for some waste types also direct disposal to the sewer at the place of generation
- Transport from generation place to a central collection point (one or several points)
- Storage and in some cases transshipment of the waste
- Internal treatment
- Transport to external treatment and disposal.

H.4.5.1 Sorting at Source of Generation

The sorting at the visited hospitals takes place in accordance with local instructions. This sorting is generally reliable and professionally executed as the staff is familiar with the waste and the risks involved. For collection and storage at the departments bins of various sizes, materials and colors are generally applied - in many cases the bin is reuse of a bin supplied with a product or material to the hospital and consequently there is no standard for the size, material and color. Lining of the bin with a plastic bag is seen at most places.

For sharps, a cardboard box (sometimes the box used for supply of syringes) or hard receptacles are used.

Some waste products like blood are typically discharged to the sewer (laboratory glassware is reused and emptied during the cleaning). Liquid chemical waste was also observed to be discharged into the sewer.

The waste is classified by the staff at the departments by identification and labeling of contaminated waste (including sharps) and waste containing human organs (pathological waste). Thus, the waste is classified into three categories, including common waste disposed of via the municipal solid waste system.

H.4.5.2 Transport from Generation Place to Central Collection Point

Collection of the waste from the departments is typically carried out by an internal sanitation service. Relocation from the various departments is executed by dedicated personnel using a push cart. Reloading of contaminated or pathological waste during the collection was not observed.

In most cases, the waste is collected several times every day from the departments.

At one hospital inspected storage of radioactive waste within the department was observed. It was informed that the radioactive materials employed are generally of low radiation types and the used materials are stored until the radiation has decreased to an acceptable level (informed to take from 60 days to up to one year). Hereafter the materials are discharged as common waste via the municipal waste service.

H.4.5.3 Central Collection Points

The central collection points are of very distinctive design from specialized buildings to installations of provisional character with poor storage conditions (in open air with the free access of dogs, cats and rodents) and poor working conditions (no lightning, stairways and narrow halls requiring manual and awkward lifting of full bags, and manual sorting or transshipment etc.). In one case it was observed that an abandoned incinerator was used for temporary storage of waste to prevent smelling.

Non-contaminated waste is collected every day by the municipal solid waste service. In case the contaminated waste is transported to external treatment this is done with varying frequency from once a day to twice a week depending on the production.

H.4.5.4 Internal Treatment

Table H.4.5a presents the inventory of internal treatment equipment found in the questionnaire survey (Annex D). For hospitals and clinics, the table includes the whole inventory.

The design and operational conditions of the incinerators are very different. However, in general, the incinerators can be characterized as simple in terms of technology and

pollution control equipment (e.g. absence of flue gas cleaning and primitive control of combustion temperatures).

Table H.4.5a Existing Internal Treatment Equipment for Medical Solid Waste

Number of institutions and % of total	Total	Hospitals	Clinics	Rural health centers	Laboratories
Autoclave *1	46 (51.1)	20 (47.6)	19 (61.3)	3 (25.0)	4 (80.0)
Pupinel *1*2	11 (12.2)	2 (4.8)	3 (9.7)	6 (50.0)	0 (0)
Incinerator	12 (13.3)	12 (28.6)	0 (0)	0 (0)	0 (0)
Home made incinerator	9 (10.0)	4 (9.5)	2 (6.5)	3 (25.0)	0 (0)

Remarks: *1: There may be more than one unit at the institution.
*2: Pupinel is a dry heating unit (up to 100 °C) applied for pasteurization.

The incinerators are of batch feeding types, however, some have possibilities for continuously feeding through a slide gate. In many cases, the incinerators are operated batch-wise with more than one start/shut-down per day. Auxiliary fuel burners (for gas (LPG) and oil) are commonly used.

The autoclave equipment is of conventional type. A steam temperature of 150 °C and above is applied at most institutions with autoclave.

H.4.5.5 Transport and External Treatment and Disposal

The majority of the pathological waste is disposed of in a biological digester at the central cemetery in Santiago. The digester is a closed concrete shaft where the waste is buried and covered with lime to sanitize the process.

There are mutual agreements between some hospitals and clinics concerning incineration of contaminated waste. Furthermore, at least one private incinerator offers treatment of medical solid waste to the clinics and hospitals.

Common waste, i.e. waste similar to domestic waste, is typically collected by the local municipality and ends at the municipal landfills.

H.4.6 Institutional System

The responsibility for the waste service at a hospital is typically placed in a sanitary service unit ('Servicio Sanitario') in the hospital with reference to the Chief of Operation.

'Comisión de Infecciones Intrahospitalarias' - The internal commission responsible for inter-hospital infections supervises the performance of the waste service. Also, the internal health service ('Servicio Salud') responsible for health and safety of the employees (occupational health) has an indirect influence/control of the performance of the internal waste service. However, it is the impression from the visits that supervision of the waste services is insufficient and - more important - internal training of the staff is generally neglected.

SESMA carries out a general control of waste management at the hospitals through 'Programa de Saneamiento Básico'. Furthermore, SESMA carries out control of emissions from hospital incinerators through PROCEFF ('Programa de Control de Emisiones de Fuentes Fijas'). Finally, the municipalities supervises the waste management in accordance with 'Ordenanzas Municipales' (municipal regulations).

It should also be mentioned that radioactive waste is under the auspice of the Chilean nuclear energy commission COENNU ('Comisión Chilena de Energía Nuclear').

H.4.7 Summary of Actions to be Implemented

Based on the investigations during site visits and the results of the questionnaire survey (ref. Annex D), the following actions should be considered.

- There is an urgent need of preparation of a Code of Practice to establish unified waste management procedures. When implemented, the Code of Practice should be enforced by MS.

- Juxtaposed with the Code of Practice, a boosting of the awareness of the hospitals' management is required in order to ensure attention to proper internal waste management procedures.

- Sorting and packaging of medical SW should take place at the point of generation in order to ensure correct classification and to avoid mistakes in the

handling. Correct packaging requires suitable receptacles being available at all times, including disposable and unbreakable packaging for sharps and pointed objects where required.

- The above-mentioned Code of Practice should implement a unified labeling system of the waste.

- Internal collection points need improvements to meet basic hygiene standards. Fencing is one necessary improvement and another basic demand would be application of a container system, so the waste is loaded directly into specialized containers when it arrives at the collection point instead of being piled on the ground.

- Safe disposal of infectious medical SW by landfilling should be developed in order to establish a proper, cost-effective alternative to internal treatment of the waste by incineration. Enforcement of air pollution standards is likely to close the majority of the existing incinerators as well as some incinerators being closed when major renovation works become urgent and funding has been allocated.

H.5 Municipal SWM

H.5.1 Generation and Disposal of Waste

The daily production of domestic waste in the Metropolitan Region is around 5,230 tons, which is equivalent to 60% of Chile's daily production. This production only comprises the waste that is collected by the municipalities (directly or through third parties), it does not include those wastes which, despite being included in the category of domestic waste, are managed directly by the generators, as is the case with supermarkets, commercial centers and industries that produce non-hazardous wastes.

This last type of waste currently represents about 10% of the total waste generated in what is known as Greater Santiago.

Table H.5.1a details the production of waste in the Metropolitan Region.

Table H.5.1a Production of urban waste in the Metropolitan Region

Waste collected by Municipalities	157,000 Tons/Month
Waste collected by generators	14,000 Tons/Month
Total production	171,000 Tons/Month

Source: Statistics for Cerros de Renca, Lepanto and Lo Errázuriz sanitary landfills, 1995.

It is important to mention the increase in waste generation in the Metropolitan Region during the last decade. One of the parameters that allow the quantification of waste generation is production per capita (P.P.C.), expressed in terms of kg/inhabitants/day. From the collected data, it is possible to determine, in the case of the Metropolitan Region, the variation of the P.P.C. in the period between 1985 and 1993 (Table H.5.1b) and how it is related to the different socio-economic levels (Table H.5.1c).

Table H.5.1b Production Per Capita of waste in the Metropolitan Region

P.P.C./Year	1985	1991	1993
Metropolitan Region	0.64	0.75	0.85

Table H.5.1c Production Per Capita by socio-economic strata (1993)

STRATA	P.P.C. (kg/inhab./day)
High	1.13
Medium High	0.91
Medium Low	0.72
Low	0.62

The increase of the population, combined with industrial development and the increase of the income, have meant a change in consumption habits and have promoted a considerable increase in the generation of solid waste.

The sub-division of the production according to socio-economic strata allows an important aspect of the study to stand out, related to the composition of waste. It appears that the higher the P.P.C., the greater the content of inert waste, and on the other hand, the lower the P.P.C., the greater the content of organic matter in the waste. This relationship is shown in Table H.5.1d.

Table H.5.1d Composition of urban waste according to socio-economic level

Socio-Economic Level	HIGH	MEDIUM HIGH	MEDIUM LOW	LOW
Production Percentage	20.5	34.1	31.6	13.7
Organic Matter	48.8	41.8	54.7	56.4
Paper and Cardboard	20.4	22.0	17.0	12.9
Ash and Earthenware Scrap	4.9	5.8	6.1	7.6
Plastics	12.1	11.5	8.6	8.1
Textiles	2.3	5.5	3.5	6.0
Metals	2.4	2.5	2.1	1.8
Glass	2.5	1.7	1.3	1.0
Bones	0.5	0.4	0.6	0.4
Other	6.1	8.7	6.1	5.8

Specific data about waste produced by the *comunas* of the Metropolitan Region, consistent with current municipal organization, are provided in Table H.5.1e.

Table H.5.1e Waste production by comuna (1995)

MUNICIPALITY	WASTE PRODUCTION TONS/MONTH
San Miguel	3257
Santiago	11457
Ñuñoa	5715
La Cisterna	3085
Providencia	4465
Maipu	7418
La Granja	3302
La Reina	2971
La Florida	7144
San Ramón	2272
La Pintana	2761
Macul	3320
Peñalolén	4004
Estación Central	3905
San Joaquín	3395
Pedro Aguirre Cerda	3261
Lo Espejo	2553
El Bosque	3199
Cerrillos	1732
Recoleta	6948
Independencia	3181
Las Condes	8644
Lo Barnechea	2182
Vitacura	4098
Conchalí	4901
Huechuraba	1769
Quinta Normal	4193
Renca	3395
Quilicura	1808
Colina	1012
Lampa	230
Pudahuel	4298
Lo Prado	3140
Cerro Navia	4443
San Bernardo	5780
Puente Alto	7000