

UBC Social, Ecological Economic Development Studies (SEEDS) Student Reports

An Investigation into Sustainable Paints

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ABSTRACT

A new Student Union Building at the Vancouver campus of UBC is being designed to become an icon and an inspiration in sustainable design and responsible operation. To come up with the most sustainable design possible, every aspect of the building has to be carefully analyzed. Some paints can have many harmful and dangerous chemicals in them that can have a significant impact on the environment, so sustainable paint is an important area to look into when designing a sustainable building. To simplify the feasibility assessment of sustainable paint, only white interior semi-gloss paints were studied. As the design of the building has not been finalized, the exact square footage of the walls and the types of surfaces to be painted are unknown, so only a very rough cost estimate can be produced.

Out of the thousands of paint types and brands on the market, three different types of paint with varying degrees of eco-friendliness were chosen from manufacturers in close proximity to UBC. The three paints analyzed were: Yolo Colorhouse Interior Semi-Gloss paint, a Green Seal certified paint from an Oregon-based manufacturer; Vancouver-based General Paint's HP 2000 Semi-Gloss, a high performance, multi-purpose paint; and Surrey-based Cloverdale Paint's "EcoLogic" Waterborne Semi-Gloss paint, which meets the EPA standards for VOC emissions. Using a triple-bottom-line comparison approach, assessing the social, environment, and economic impacts of the paints, the feasibility of using each of the three paints for the new SUB building was analyzed. A weighted decision matrix was used to quantitatively evaluate the three selected types of paints on the basis of cost, environmental impact, disposability, carbon footprint and the manufacturer's position on social responsibility. From the assessment, Cloverdale Paint's "Ecologic" brand of paint was found to rank the highest overall, followed by General Paint HP 2000, and then Yolo Colorhouse Interior Semi-Gloss paint.

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GLOSSARY

Non-Flat: Paint or coating whose specular gloss registers 5 or greater on a 60-degree meter according to ASTM Method D 523-89, Standard Test Method for Specular Gloss Paint.

Refractive Index: The ratio of the speed of light in a vacuum to the speed of light in a medium under consideration.

Topcoat: The outermost layer of a paint or coating system.

Volatile Organic Compound: Any organic compound which participates in atmospheric photochemical reactions as defined by the U.S. EPA and has an initial boiling point lower than or equal to 280°C measured at standard conditions of temperature and pressure.

LIST OF ABBREVIATIONS

ASTM: American Society for Testing and Materials

CRGI: Coatings Research Group, Incorporated

EPA: Environmental Protection Agency

HHW: Household Hazardous Waste

IARC: International Agency for Research on Cancer

ISO: International Organization for Standardization

LEED: Leadership in Energy and Environmental Design

MSDS: Material Safety Data Sheet

VOC: Volatile Organic Compound

WDM: Weighted Decision Matrix

1.0 INTRODUCTION

As awareness of the negative social and environmental impacts associated with common consumer activities increase globally, many companies, institutions, and organizations are now taking an active role in promoting sustainability in their everyday practices. Corporate decision making that was once only determined by financial costs and revenues now takes into account the social, environmental, and economic impacts of using a certain material, creating a new product, or implementing new technology - what is referred to as a "triple-bottom-line" assessment.

UBC in particular was the first university in Canada to open up a Sustainability Office in 1998. The Sustainability Office's SEEDS (Social Ecological Economic Development Studies) Program was established in 2001, and has since then been constantly working with UBC faculty, students, and staff on new and innovative ideas to improve campus sustainability, from green building design, conservative water and energy practices, socially responsible food services, to waste management. The purpose of this report is to assist the SEEDS Program in sustainable building design for the New Student Union Building (SUB) at UBC by providing a triple-bottom-line assessment of a number of paints that may be used for finishing the surfaces of the New SUB and refurbishing the current SUB, and recommending the most sustainable paint brand based on this assessment.

The three paints chosen for comparison in this report are the Yolo Colorhouse Interior Semi-Gloss paint, General Paint HP 2000 Semi-Gloss paint, and Cloverdale Paint "EcoLogic" Waterborne Semi-Gloss paint, pictured in Figure 1 below.



Figure 1: Three Potential Paint Brands (from left to right: Yolo Colorhouse Interior Semi-Gloss paint, General Paint HP 2000 Semi-Gloss paint, and Cloverdale Paint EcoLogic Waterborne Semi-Gloss paint)

<http://www.yolocolorhouse.com/>, <http://www.generalpaint.com/>, <http://www.cloverdalepaint.com/>

Yolo Colorhouse is an Oregon-based company that manufactures environmentally-friendly paints, and its 100% acrylic Interior Semi-Gloss paint is advertised to perform like a premium conventional paint, yet with low odour, minimal harmful chemicals, and no added solvents.

General Paint's HP 2000 Semi-Gloss paint is designed for residential and commercial, interior and exterior use, and is advertised to be a high-performance paint with excellent hiding power and incredible scrub resistance. It is also advertised to be ideal for all high traffic areas that require an extra tough and durable finish.

Cloverdale's "EcoLogic" Waterborne Semi-Gloss paint is advertised to be a self-priming, low-odour, waterborne enamel coating that can be used for both interior and exterior surfaces, exhibiting superior adhesion and washability characteristics that make it ideal for areas exposed to moisture and high humidity.

2.0 ENVIRONMENTAL ASSESSMENT

The key environmental issues that must be addressed when choosing a sustainable paint brand include energy conservation, air and water quality, hazardous substances, and disposability. The paint manufacturing process is not typically energy intensive, accounting for merely 1-5% of the total energy requirements of most paint company activities. Instead, transport of paint from production facilities to warehouses and dealers accounts for 60-70% of the total energy requirements of most paint companies. Some volatile organic compounds (VOCs) that are common in paint products are known to have adverse effects on air quality and cause human health problems when inhaled, including damage to the liver, kidney, and central nervous system over long-term exposure. Traditional high-performance paints have been known to contain dangerous amounts of heavy metals, namely lead compounds, which are used as pigments and are also added to paint to speed drying, increase durability, retain a fresh appearance, and resist moisture that causes corrosion. Human exposure to lead can cause kidney damage, reproductive problems, and affect every organ system of the body. Leaded paints have been prohibited for domestic use in many countries, such as Canada, the United States, and the United Kingdom, although paint with significant lead content is still used for industrial and military applications. Other metals that may occur in small levels in paint include mercury, cadmium, chromium, and antimony, all of which may also cause liver and blood damage. Due partly to these hazardous materials, paint disposal is a concern to human and environmental health. Additionally, improperly disposed latex paint can contribute to suffocation of aquatic ecosystems. Paint contains petroleum-derived ingredients, a non-renewable polluting resource extracted from unstable and ecologically sensitive regions. Latex recycled low-VOC and zero-VOC paints mitigate disposal challenges and reduce risks to human health and the environment. More specifically, recycled paint manufacturing conserves resources by reusing waste materials. It is important to note, however, that recycled paint has VOC levels approximately equal to its feedstock.

Our environmental assessment of the three paints chosen for comparison will take into account any environmental certification standards held by the paint, the carbon footprint of transporting the paint from production facilities, to retail stores, and finally to UBC, the VOC and hazardous substance levels in each paint brand, and the required disposability methods for each paint.

2.1 COMPARISON OF ENVIRONMENTAL CERTIFICATION STANDARDS

In North America, the three most widely-used environmental certification standards for paint are currently the GreenWise^{CM}, EcoLogo^{CM}, and Green SealTM standards. The GreenWise label was established by Ohio-based Coatings Research Group, Incorporated, that tests and certifies products from its ISO 17025 accredited facility. CRGI is an active member of the United States Green Building Council and consists of members from 30 different paint manufacturing companies. The EcoLogo standard was founded in 1988 by the Government of Canada, is ISO 14024 accredited, and certifies a variety of consumer products such as cleaning supplies, fuels, lubricants, construction products, and packaging. The US-based Green Seal is a nonprofit organization that was founded in 1989 and now certifies products in more than 40 different categories, ranging from coffee filters to air chillers.

Criteria listed on the most recent publications of the Green Wise, EcoLogo, and Green Seal standards that apply to non-flat, interior topcoat paints can be found on the table below:

Table 1: Comparison of Certification Standards

	Green Wise^{CM}	EcoLogo^{CM}	Green SealTM (GS-11)
VOC limit	100 g/L	100 g/L	100 g/L
Contrast Ratio	0.95 min	n/a	0.95 min
Y-Reflectance	80% min	n/a	80% min
Washability	7 min	7 min	7 min
Restricted Chemicals and Compounds	benzene, naphthalene, 1,2 dichlorobenzene, phthalates, isophorone, antimony, cadmium, hexavalent chromium, lead, mercury, formaldehyde, methyl ethyl ketone, methyl isobutyl ketone, acrolein, acrylonitrile	benzene, naphthalene, 1,2 dichlorobenzene, isophorone, methyl ethyl ketone, methyl isobutyl ketone, phthalates, formaldehyde, antimony, cadmium, hexavalent chromium, lead, mercury, acrolein, acrylonitrile	1,2 dichlorobenzene, alkylphenol ethoxylates, formaldehyde-donors, lead, mercury, cadmium, hexavalent chromium, antimony, phthalates, triphenyl tins (TPT), tributyl tins (TBT)

Although the EcoLogo standards did not list minimum requirements for the contrast ratio and y-reflectance, parameters that are used to measure the overall hiding power of a given paint, all three standards appear to have similar criteria for certification. Namely, the VOC limit and list of restricted chemicals and compounds are nearly identical for all three environmental standards. Therefore, the

Green Wise, EcoLogo, and Green Seal labels will all be deemed to have equal environmental value for the purposes of this report.

The Yolo Colorhouse paint has been Green Seal certified for the revised GS-11 2008 standards, which also qualifies it for projects certified by LEED - a rating system developed by the US Green Building Council system that measures how "green" a building is. The Cloverdale EcoLogic paint has not been certified by Green Wise, EcoLogo, or Green Seal, but does meet the United States Environmental Protection Agency (EPA) national VOC emission standards for architectural coatings. The General Paint HP 2000 does not hold any environmental certifications, but has been accepted for use in registered establishments by the Canadian Food Inspection Agency (CFIA).

2.2 CARBON FOOTPRINT ASSESSMENT

The carbon footprint associated with transporting the paint to and from different locations is another environmental criterion to be evaluated. The carbon footprint of each paint supplier is calculated based on the total distance the paint needs to travel from production facilities, to retail stores, and finally to UBC. For transportation of each paint brand, the tonnage of CO₂ was calculated and values are listed in Table 2 below.

Table 2: Carbon Footprint Comparison

	Yolo Colorhouse Interior Semi-Gloss	Cloverdale Paint "EcoLogic" Waterborne Semi-Gloss	General Paint HP 2000 Semi- Gloss
Distance Travelled (km)	510.4	40.6	14.2
Carbon Footprint (tonnes of CO₂)	0.27	0.02	0.01

As the Yolo Colorhouse Interior Semi-Gloss paint is manufactured in Portland, Oregon, it needs to travel the longest distance to arrive at UBC, resulting in a relatively high carbon footprint. The other two paint suppliers, Cloverdale Paint and General Paint, are located in Surrey and Vancouver respectively, so the distance required to travel to UBC is less. As a result, the carbon foot print is substantially smaller.

2.3 VOC AND HAZARDOUS SUBSTANCE ASSESSMENT

The choice of paint for a building directly affects the health of the people living or working inside it. According to the US Environmental Protection Agency (EPA), indoor air pollution is one of the top five risks to human health. In fact, the adverse effects on human health that are associated with indoor air pollution are 2 to 5 times worse than those associated with outdoor air pollution. In the case of a new construction or renovation project, these adverse effects can be as much as 100 or even 1000 times worse. As people spend almost 90% of their time indoors, it is clear that indoor air quality must be controlled.

One of the major ways to control indoor air quality is to choose a paint with the lowest VOC level as possible. Environmentalists and health experts agree that VOCs increase indoor air pollution and may be carcinogenic to humans. Even after a layer of paint dries, VOCs can continue being released from the solid coating for many years afterward.

To limit the VOC levels in indoor air, the best way is to choose eco-friendly paints with low-VOC or even zero-VOC levels. The general instructions for choosing an eco-friendly paint are listed below:

1. Know that low-VOC and zero-VOC paints must meet standards set by the U.S. Environmental Protection Agency. Low-VOC paints can have 200 grams of volatile compound per liter at the most. Paints with less than 5 grams per liter are considered to be zero-VOC products.
2. Understand that VOCs can be eliminated altogether if natural interior paints are used. Natural paints often incorporate plant dyes and minerals. For example, clay paint is made from minerals and water. However, the color selection for clay paints may be limited, and walls painted with them cannot be washed if they get dirty - they must be repainted.
3. Consider milk paint as another natural alternative for interior paint that has been used for centuries. It is made from a milk protein, water, clay, and pigments. It is a fast-drying paint that typically comes in powder form to be mixed with water.
4. Look for eco-friendly paints that meet Green Seal standards.

Aside from VOCs, a common substance found in many paints is titanium dioxide, which is the most widely used white pigment in paint due to its brightness and very high refractive index. Titanium dioxide has been widely regarded as a hazardous ingredient due to its carcinogenicity. The International Agency for Research on Cancer (IARC) has classified titanium dioxide as possibly carcinogenic to humans based on sufficient evidence of carcinogenicity in experimental animals. In one specific study, it was found that, “In a lifetime inhalation study, exposure to 250 mg/m³ titanium dioxide dust resulted in the development of lung tumors in rats. These tumors occurred only at dust levels that overwhelmed the animals' lung clearance mechanisms and were different from common human lung tumors in both type and location” (CP, 2007).

The levels of VOCs and titanium dioxide were extracted from the Material Safety Data Sheets (MSDS) for each paint brand (please refer to Appendix A,B,C) and are summarized in Table 3 below.

Table 3: VOC and Titanium Dioxide Levels

BRAND	VOC LEVEL (g/L)	TITANIUM DIOXIDE LEVEL (mg/m³)
YOLO Colorhouse Interior Semi-Gloss Paint	<100	15
General Paint HP 2000 Semi-Gloss Paint	244	10
Cloverdale Paint "EcoLogic" Waterborne Semi-Gloss Paint	203	10

According to Table 3, the YOLO Colorhouse Interior Semi-Gloss paint has the lowest VOC level, but has a slightly higher level of titanium dioxide. The titanium dioxide levels for both the General Paint HP 2000 and Cloverdale Paint "EcoLogic" are the same; nevertheless, the Cloverdale Paint "EcoLogic" just barely qualifies as a low-VOC paint, while the General Paint HP 2000 does not qualify as a low-VOC paint at all. Since the levels of titanium dioxide found in these three paints fall well below the tested carcinogenic level of 250mg/m³, all three paints can be considered to have relatively low levels of hazardous materials, with the Yolo Colorhouse paint containing only slightly higher levels of hazardous materials than the Cloverdale Paint and General Paint varieties.

2.4 DISPOSAL METHODS

Before considering the disposal of leftover paint, it is necessary to know how to clean the actual equipment that was used for the painting job. The technique used for equipment cleaning is dependant upon the type of paint that was used: water-based or oil-based paint. For water-based paint, it is safe to wash paint brushes directly in a kitchen or bathroom sink. Brushes should not be rinsed outside on the street as storm drains flow directly into local waterways without proper treatment. For oil-based paint, the equipment should be cleaned by rinsing brushes with a solvent in a container. The thinner and solvent may then be filtered and reused. Any unusable liquids or residues should be taken to a household hazardous waste (HHW) collection center for proper disposal.

In general, paint disposal processes are the same for all varieties of paint. According to Federal and Provincial Laws in Canada, all paint products must be disposed of through a licensed waste disposal company. Manufacturers must also provide clear instructions for disposal on the paint container label. Similar to the unusable liquids and residues that are a by-product of the cleaning of painting equipment, the disposal of all unused paint should occur at a household hazardous waste collection center. In British Columbia, the Product Care Association operates several waste collection centers that provide safe disposal of paints and flammable liquids. Product Care is a non-profit, industry-sponsored association established by members of the paint and flammable liquid industries that manages product stewardship programs across Canada for household hazardous waste. There are three Product Care disposal facilities operating in Vancouver. The fees for disposal of canned paint depend on the amount, or volume, being disposed of, as outlined in Table 4 below.

Table 4: Product Care Paint Disposal Fees for BC

Volume Disposed	Cost
100mL - 250mL	\$0.20
251mL - 1L	\$0.25
1.01L - 5L	\$0.50
5.01L - 23L	\$1.25
Aerosol Paint (any size)	\$0.25

Although the Yolo Colorhouse, General Paint, and Cloverdale Paint varieties may all be disposed of at any Product Care facility in British Columbia, the Yolo Colorhouse Interior Semi-Gloss paint offers a unique alternate disposal method that is environmentally-friendly, free, and does not require transporting unused paint to a designated HHW facility — any unused Yolo Colorhouse paint can be poured into an absorbent material, allowed to dry, and be disposed of along with regular household trash. Furthermore, under Yolo Colorhouse’s new manufacturing standard, it is possible for customers to purchase only the volume of paint that they require for a certain project, reducing the amount of leftover paint requiring disposal with the added advantage of reducing paint costs.

In summary, regardless of the paint brand being used, the disposal process must follow federal and provincial government regulations by bringing leftover paint to a HHW collection centre. However, the Yolo Colorhouse Interior Semi-Gloss paint provides the most convenience of disposal.

3.0 ECONOMIC ASSESSMENT

Cost can be a very important determining factor when choosing a paint type. The three paints investigated — the Yolo Colorhouse Interior Semi-Gloss, General Paint HP 2000, and Cloverdale Paint “EcoLogic” Waterborne Semi-Gloss paint — each meet different sustainability standards, but are all comparable in durability and surface finish. It is important for paint to produce a tough and durable surface because it will be easier to clean and will require fewer recoats and touch-ups, reducing the lifecycle cost of the paint. The cost of a paint type can differ substantially, depending on the quality of the product. Higher quality paints will last longer and be easier to clean than their cheaper counterparts. The three brands of paint listed were chosen based on their manufacturing proximity to UBC. Paints that are manufactured close to their intended place of use will have shorter transportation times, and smaller environmental costs. A comparison of the three investigated brands of paint can be found in Table 5 below.

Table 5: Comparison of Paint Costs and Levels of Durability

Brand	Yolo Colorhouse Interior Semi-Gloss Paint	General Paint HP2000 Semi-Gloss Paint	Cloverdale Paint "EcoLogic" Waterborne Semi-Gloss Paint
Certification	Green Seal certified	n/a	Meets EPA standards for VOC emissions
Company Location	Portland, Oregon	Vancouver, BC	Surrey, BC
Estimated Cost (\$/gal)	\$50.00	\$30.00	\$40.00
Average Coverage (ft²/gal)	400	385	327
Estimated Cost per Square Foot	\$0.13	\$0.08	\$0.12
Transportation Costs	\$10.00	\$1.93	\$3.96
Washability	durable, washable finish	extra tough and durable finish	superior adhesion, scrubability and is resistant to stains and mildew

As shown in the table above, Yolo Colorhouse meets the highest green standards, but it is also the most expensive. As it is manufactured in Portland, Oregon, it also has a higher transportation cost. However, when purchased in bulk, the transportation costs per gallon of paint could be significantly reduced. Cloverdale’s “Ecologic” is the second most expensive paint per square foot of wall, but it has a much

lower transportation cost associated with it when compared to the Yolo Colorhouse Paint since it is manufactured and sold in the Lower Mainland. General Paint's HP 2000 line of paint is significantly less expensive than the other two paint alternatives listed, estimated to only be \$0.08 per square foot and it also has the lowest transportation cost associated with it. Unfortunately, this paint does not meet any sustainability certification standards and has high levels of VOCs. General Paint is advertised as having excellent hiding power with incredible scrub resistance, but all three paints claim to produce tough, durable, and easily washable surfaces.

The cost of each paint is subject to change based on the amount of paint required. While it would cost more upfront to use a green-certified paint, having less toxic fumes would create a healthier and more sustainable environment for the painters and the users of the SUB. The cost will be an important factor in assessing the triple-bottom-line for the use of sustainable paint for the new SUB building.

4.0 SOCIAL ASSESSMENT

The social assessment of the paints from the three different suppliers is an important aspect in the overall triple-bottom-line assessment of sustainability, and is easily the most difficult aspect to evaluate due to its complexity and the lack of quantifiable information available on social issues surrounding paint manufacturing. For purposes of this report, the social assessment of each variety of paint will encompass three key social aspects of the company that manufactures it: environmental commitment, employee treatment, and community involvement. This analysis will provide a better understanding of each company's mandate and visions for their products, and aid in the selection of a social-friendly paint for the new SUB.

4.1 GENERAL PAINT

General Paint is a local paint supplier in Vancouver with a mission to “combine a thorough knowledge of the paint business with an eagerness for new ideas” (GP, 2007). General Paint is actively involved in several community initiatives in the city of Surrey. Partnering with the Provincial and Federal Government, General Paint runs an ongoing program that donates paint and supplies to Sullivan Heights Secondary School in Surrey for use in student projects. General Paint is also one of the sponsors of the BC Cancer Foundation Tour of Courage Community Ride with Lance Armstrong. Another community initiative General Paint takes part in is the Stream of Dreams Eco-Education program, educating students and communities about the function of and life surrounding watersheds, rivers, and streams through the creation of a colourful mural (Figure 2). General Paint is committed to reducing the environmental impact of its products through the research and development of Z-Coat, a substance that aids in reducing VOC levels in paint products to zero.



Figure 2: Stream of Dreams Mural

<http://www.generalpaint.com/>

4.2 CLOVERDALE PAINT

Cloverdale Paint is another local company based in Surrey that is committed to the quality of its products and superior customer service. Both internal and external to the company, Cloverdale Paint is involved in several environmental programs that advocate the idea of sustainability. Internally, Cloverdale Paint promotes sustainability in office supplies by operating recycling programs for cardboard and office papers, and programs for the re-utilization of water, solvent liquids, and solid waste. Furthermore, Cloverdale Paint is involved in the Coating Care program, which aims to protect the health of paint manufacturing employees and the community by finding solutions to specific industrial concerns such as transportation, distribution, manufacturing management, and community responsibility. Similar to General Paint, Cloverdale Paint is also devoted to the production of water-based and low-VOC paints and coatings. In addition, Cloverdale Paint is active in many industrial associations, such as the National Paint and Coating Association and the GVRD – Lower Fraser Valley Air Quality Advisory Committee, which develops new coating and paint standards and technology.

4.3 YOLO COLORHOUSE

Yolo Colorhouse is a US-based company located in Portland, Oregon. Their mission statement is as follows:

- To connect to our community as artists, teachers, and environmentalists
- To design our products to inspire confidence and creativity
- To bring environmental and social values to the workplace
- To be passionate about and committed to what we do everyday

Yolo Colorhouse exhibits its commitment to the environment in several ways, from its choice of packaging and displays, manufacturing practices, and factory energy use. Yolo Colorhouse's product packaging uses post-consumer recycled plastic with soy ink print labels, and store sales displays are made with cardboard and wheat board. Yolo Colorhouse also utilizes a renewable energy source — wind power — for its company headquarters. Besides purchasing wind power energy for its offices, Yolo Colorhouse encourages its employees to reduce their own greenhouse emission level by subsidizing employees who take public transportation or car-pool to work. Due to these eco-friendly

practices, Yolo Colorhouse won the Recycle Works award from the Portland Office of Sustainable Development in 2007, and BEST award in 2008 (Businesses for an Environmentally Sustainable Tomorrow).

5.0 TRIPLE-BOTTOM-LINE DECISION MATRIX

In order to numerically assess the sustainability value of each of the three paint varieties compared in the report, a weighted decision matrix (WDM) was utilized and is presented in Table 6 below.

Table 6: Triple-Bottom-Line Weighted Decision Matrix

	Evaluation Criterion	Weight	Yolo Colorhouse	General Paint	Cloverdale Paint
Environmental Assessment (Total Weight: 40%)	Ecolabel Certified	8%	100	0	25
	Hazardous Materials	8%	80	90	90
	Disposability	8%	100	60	60
	VOC Level	8%	100	0	40
	Carbon Footprint	8%	70	100	95
Economic Assessment (Total Weight: 30%)	Cost per Square Meter Painted	10%	70	100	95
	Transportation Costs	10%	0	100	75
	Disposal Costs	10%	100	60	60
Social Assessment (Total Weight: 30%)	Social Responsibility of Manufacturer	30%	80	90	70
Total		100%	53.24	55.18	68.8

As can be seen in the above table, the Cloverdale Paint “EcoLogic” Waterborne Semi-Gloss paint has the highest total sustainability value, with the General Paint HP 2000 Semi-Gloss paint rating second, and the Yolo Colorhouse Interior Semi-Gloss scoring the lowest in the triple-bottom-line assessment.

6.0 CONCLUSIONS AND RECOMMENDATIONS

After compiling the results of our research on each of the three paint brands in a weighted decision matrix (as per Table 6), it has been determined that the Cloverdale Paint “EcoLogic” Waterborne Semi-Gloss paint fares the best in the triple-bottom-line assessment of sustainability and therefore is the best choice for paint to be used on the new SUB. Based on our research, the most significant advantages of using the Cloverdale Paint variety are its low cost and close vicinity to UBC, which provide both economic and environmental benefits. The cost per square meter painted is similar to the General Paint HP 2000, and significantly lower than the Yolo Colorhouse Interior Semi-Gloss paint. Furthermore, as a local brand, the Cloverdale Paint “EcoLogic” yields substantially lower transportation costs and a small carbon footprint in comparison to the Yolo Colorhouse product located in Portland, Oregon. As shown in the WDM, the Cloverdale Paint variety is not the most environmental-friendly paint product due to its moderate VOC level, however it does meet all government environmental safety requirements, and has similar washability performance to the General Paint HP 2000. However, if the Yolo Colorhouse product were to be manufactured and sold in British Columbia, it would likely prove to be the most sustainable paint as the high carbon footprint associated with transportation would be diminished.

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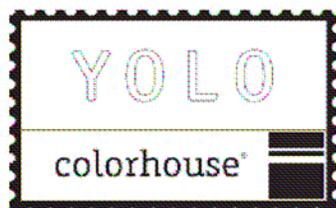
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APPENDICES

APPENDIX A: YOLO COLORHOUSE MSDS



www.yolocolorhouse.com

MATERIAL SAFETY DATA SHEET

YOLO Colorhouse® Inside – Semi-Gloss White

1 – CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

General use: Paint

Product codes: 111318, 111332, 111356

Common name: Interior Semi-Gloss White

HMIS codes: H F R P

Country/countries: U.S.

I I O C

Emergency telephone number: 1-800-424-9300 (CHEMTREC)

Distributed by: YOLO Colorhouse LLC, 3909 NE Martin Luther King Jr Blvd, Suite 201, Portland, OR 97212, 503-493-8275

2 – HAZARDS IDENTIFICATION

Emergency overview: White, aqueous liquid with mild odor.

Caution: May cause eye and skin irritation.

Target organs: eyes, skin

Potential environmental effects: See Section 12 for more information.

3 – COMPOSITION, INFORMATION ON INGREDIENTS

Product contains the following hazardous ingredients:

Component	CAS No.	Max. %
Titanium dioxide	13463-67-7	20
Inert pigment	37244-96-5	24
Acrylic resin	Confidential	70

4 – EMERGENCY AND FIRST AID MEASURES

Inhalation: Move to fresh air. If breathing is difficult, give oxygen. Get medical attention if symptoms occur.

Skin contact: Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention if symptoms occur. Wash clothing before reuse. Destroy contaminated shoes.

Eye contact: Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses if possible. Get medical attention immediately.

Ingestion: Do NOT induce vomiting. Get medical attention immediately. Do NOT administer anything by mouth to an unconscious person.

5 – FIRE FIGHTING MEASURES

Extinguishing media: Aqueous mixture – not flammable.

Special fire fighting procedures: Use CO₂, dry chemical, foam, or water fog in fighting fires involving this product. Use self-contained breathing apparatus and full protective clothing.

Unusual fire and explosion hazards: None.

Hazardous decomposition products: Oxides of carbon, silicon, aluminum, and titanium.

6 – ACCIDENTAL RELEASE MEASURES

Wear appropriate personal protection equipment. Contain spilled material with dikes or sandbags. Keep out of water supplies and sewers. Notify the appropriate authorities immediately. Take all additional action necessary to prevent and remedy the adverse effects of the spill. Dispose of as household waste.

7 – HANDLING AND STORAGE

Handling: Avoid contact with skin, eyes, and clothing. Wash thoroughly after handling.

Storage: Store in original container. Store in a cool, dry place. Keep container tightly closed.

8 – EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure guidelines:

Component	OSHA TWA	ACGIH TWA/STEL
Titanium dioxide	15 mg/m ³	10 mg/m ³
Inert pigment	5 mg/m ³	5 mg/m ³
Acrylic resin	none	none

Engineering controls: Control the airborne concentrations below the exposure limits. Use only with adequate ventilation.

Personal protection:

Respiratory: NIOSH approved self-contained breathing apparatus for exposure over PEL.

Skin protection: Protective gloves are recommended.

Eye protection: Recommended.

9 – PHYSICAL AND CHEMICAL PROPERTIES

Appearance: white, aqueous liquid

Odor: mild

Viscosity: 100-105 KU

Specific gravity: 1.120-1.439

Solubility in water at 20°C: miscible pH: 9.5-10

Freezing point: not determined

Boiling point: not determined

Self-igniting: does not self-ignite

Flash point: not applicable

10 – STABILITY AND REACTIVITY

Stability: Stable.

Hazardous polymerization: Will not occur.

Incompatibility: Avoid contact with strong oxidizing and reducing agents.

Hazardous thermal decomposition products: Thermal decomposition will produce oxides of carbon, silicon, aluminum, and titanium.

11 – TOXICOLOGICAL INFORMATION

Eye: Ingredients may cause eye irritation.

Skin: Ingredients may cause skin irritation.

Ingestion: No data available for product.

Inhalation: No expected effects due to formulation.

Sensitization: No known effects.

Carcinogenicity: The ingredients in this product are not listed by NTP, OSHA, or IARC as human carcinogens.

12 – ECOLOGICAL INFORMATION

Biodegradability: No data available.

Fish toxicity: No data available.

Daphnia magna toxicity: No data available.

Algae toxicity: No data available.

13 – DISPOSAL CONSIDERATIONS

Material collected on absorbent material may be deposited in an approved landfill. Treatment, storage, transportation, and disposal must be in accordance with applicable federal, state/provincial, and local regulations.

14 – TRANSPORT INFORMATION (not meant to be all inclusive)

DOT: Not regulated

15 – REGULATORY INFORMATION (not meant to be all inclusive)

United States: The ingredients of this product are listed on the TSCA Inventory. This product is considered hazardous under the OSHA Hazard Communication Standard. SARA Section 313: no ingredients listed. Clean Air Act Section 112(b): no ingredients listed.

16 – OTHER INFORMATION

MSDS status: Written July 16, 2007

DISCLAIMER AND LIMITATION OF LIABILITY

This information is supplied as a resource only. It should not be taken as a warranty or representation for which YO!O Colorhouse assumes legal responsibility. The information contained is believed to be accurate and compiled from sources believed to be reliable. It is the responsibility of the user to investigate and verify its validity. The user assumes all responsibility of using and handling the product in accordance with applicable federal, state and local regulations.

APPENDIX B: GENERAL PAINT MSDS

MATERIAL SAFETY DATA SHEET

SECTION 1 - PRODUCT INFORMATION

Product Identifier: 58-020 HP2000 SEMI-GLOSS WHIT			
Product Use: Protective Coating			
Manufacturer's Name: General Paint Corp.		Supplier's Name: General Paint Corp.	
Street Address: 950 Raymur Ave		Street Address: 950 Raymur Ave	
City: Vancouver	Province: BC	City: Vancouver	Province: BC
Postal Code: V6A 3L5	Emergency Phone: (604) 253-4022	Postal Code: V6A 3L5	Emergency Phone: (604) 253-4022

SECTION 2 - HAZARDOUS INGREDIENTS

Hazardous Ingredients(<i>Specific</i>)	%	CAS Number	LD 50 of Ingredient(Specify species,route)	LC 50 of Ingredient(Specify species)
DIETHYLENE GLYCOL MONOBUTYL ETHER	1.51 - 1.52	112-34-5	5660 MG/KG(ORAL, RAT)	NOT AVAILABLE
TITANIUM DIOXIDE	18 - 21	13463-67-7	NOT AVAILABLE	NOT AVAILABLE
PROPYLENE GLYCOL	5 - 6	57-55-6	20000 MG/KG(ORAL, RAT)	NOT AVAILABLE

SECTION 3 - PHYSICAL DATA

Physical State: Liquid	Odour and Appearance: liquid with a slight ammonia smell	Coating VOC(gm/l): 244	Odour Threshold(ppm): Not Available
Specific Gravity: 1.23	Vapor Density(air=1): Not Available	Vapor Pressure(mmHg): Not Available	Evaporation Rate: Not Available
Boiling Point(° C): Greater than 100°C	Freezing Point(° C): Less than 0°C	pH: 8.5-9.5	Coefficient of Water/Oil Distribution: Not Available

SECTION 4 - FIRE AND EXPLOSION DATA

Flammability: No	If yes, Under which Conditions? Not Applicable	
Means of Extinction: Alcohol foam, Carbon dioxide, Dry chemical powder, Polymer foam		
Flashpoint and Method: "Not Applicable	Upper Flammable Lt (% by Volume): Not Applicable	Lower Flammable Lt (% by Volume): Not Applicable
Autoignition Temperature: Not Applicable	Explosion Data - Sensitivity to Impact: No	Explosion Data - Sensitivity to Static discharges: No
Hazardous Combustion Pdts: carbon monoxide, carbon dioxide, aldehydes, nitrogen oxides, sulfur oxides, methyl methacrylate, butyl acrylate, carbone dioxide, methane		

SECTION 5 - REACTIVITY DATA

Chemical Stability: Stable	If Yes, Under which Conditions? Not Applicable
Incompatibility with other substances: Yes	If yes, which ones? Strong Acids Strong Oxidizing agents Strong Bases
Reactivity, and under what conditions? heat, ignition sources, nitric acid, dichlorohydrantion, heat, sparks, or other ignition sources, generation of dust	
Hazardous Decomposition Products: oxides of nitrogen, ammonia, carbon monoxide, carbon dioxide, aldehydes	

SECTION 6 - TOXICOLOGICAL PROPERTIES

Route of Entry	Skin Contact: Yes	Absorption: Yes	Eye Contact: Yes	Inhalation: Yes	Ingestion: Yes
Effects to Acute exposure to Product: DIETHYLENE GLYCOL MONOBUTYL ETHER has been known to cause RESPIRATORY TRACT IRRITATION, EYE IRRITATION and SKIN IRRITATION.					
Effects to Chronic exposure to Product: DIETHYLENE GLYCOL MONOBUTYL ETHER has been known to cause CENTRAL NERVOUS SYSTEM DAMAGE, CYANOSIS, ACIDOSIS, KIDNEY INJURY. PROPYLENE GLYCOL has been known to cause LACTIC ACIDOSIS.					
Exposure Limits (Value,Units,By) DIETHYLENE GLYCOL MONOBUTYL ETHER: N/A TITANIUM DIOXIDE: 10 mg/m3 ACGIH PROPYLENE GLYCOL: 10 mg/m3 AIHA					
Irritancy (if yes, explain) DIETHYLENE GLYCOL MONOBUTYL ETHER is a skin and eye irritant. (EYE IRRITANT)					
Sensitization (if yes, explain)			Carcinogenicity (if yes, explain) TITANIUM DIOXIDE is possibly carcinogenic to humans(2B) by IARC.		
Reproductive Toxicity (if yes, explain)			Teratogenicity (if yes, explain)		
Mutagenicity (if yes, explain)			Synergistic Products (if yes, explain)		

SECTION 7 - PREVENTIVE MEASURES

Personal Protective Equipment	Gloves: Yes	Respirator: Yes	Eye: Yes	Footwear: No	Clothing: No	Other: No
If checked, specify type: Gloves: BUTYL RUBBER Eye: SPLASH RESISTANT Respirator: NIOSH APPROVED						
Engineering controls (specify such as ventilation, enclosed process): Use mechanical ventilation to reduce exposure, ground all equipment and avoid exposure to open flames or sparks.						
Leak and Spill Procedure: Wear adequate protective equipment and eliminate all ignition sources. Contain spill with absorbant material and place in a suitable covered and labeled container for disposal.						
Waste Disposal: Check with Federal, Provincial and local government regulations and requirements for disposal.						
Handling Procedures and Equipment: Use in a well ventilated area. Do not use with incompatible substances and keep away from heat and all ignition sources. Use grounded and non-sparking equipment only.						
Storage Requirements: Store in a cool, well ventilated area out of direct sunlight. Store away from heat and all ignition sources. Storage facility should be manufactured out of fire resistant materials.						
Special Shipping Information: None Required						

SECTION 8 - FIRST AID MEASURES

Inhalation: Remove to fresh air. Get medical help if there is any breathing difficulty.
Ingestion: Do not induce vomiting unless directed by a physician. If conscious and alert, give two glasses of water. Seek medical attention immediately.
Skin Contact: Remove Contaminated clothing (including shoes) and wash before reuse. Flush with large amounts of soap and water. If irritation persists, seek medical attention.
Eye Contact: Flush eyes with large amounts of lukewarm water for 20 minutes, while holding eyelids open or until irritation subsides. If irritation persist, get medical attention.

SECTION 9 - PREPARATION INFORMATION

Prepared by: General Paint Technical Dept	Phone: (604) 253-3131	Preparation Date: Jul 23, 2007
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EXTINGUISHING MEDIA:

Use extinguishing media appropriate to surrounding fire.

SPECIAL FIREFIGHTING PROCEDURES

Handle as a non-flammable liquid.

UNUSUAL FIRE AND EXPLOSION HAZARDS

Closed containers may explode when exposed to extreme heat.

FLAMMABILITY - T.D.G.R. CLASS:

Not regulated.

SENSITIVITY TO IMPACT: NO

AUTO-IGNITION TEMPERATURE:

Not available

SENSITIVITY TO STATIC DISCHARGE: NO

HAZARDOUS COMBUSTION PRODUCTS:

Not available.

===== SECTION V - REACTIVITY DATA =====

CHEMICAL STABILITY: STABLE

CONDITIONS TO AVOID:

Excessive heat, poor ventilation, corrosive atmospheres, excessive aging.

INCOMPATIBILITY (MATERIALS TO AVOID)

Alkaline materials, strong acids and oxidizing agents.

HAZARDOUS DECOMPOSITION OR BYPRODUCTS: NONE KNOWN

HAZARDOUS POLYMERIZATION:

Will not occur.

===== SECTION VI - TOXICOLOGICAL DATA =====

INHALATION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Excessive exposure to vapours or spray mists may cause minor irritation to the eyes, nose and throat.

SKIN AND EYE CONTACT HEALTH RISKS AND SYMPTOMS OF EXPOSURE

Eye Contact: May cause minor irritation, tearing, redness and blurred vision. Skin Contact: May cause minor irritation.

SKIN ABSORPTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

May dry and defat skin causing cracks, irritation and dermatitis.

INGESTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE

May cause gastrointestinal irritation, vomiting, nausea and diarrhea.

HEALTH HAZARDS (ACUTE AND CHRONIC)

Acute health hazards are as listed above. No chronic health hazards.

SENSITIZING CAPABILITY: NONE KNOWN

CARCINOGENICITY: NTP CARCINOGEN:No IARC MONOGRAPHS:Yes OSHA REGULATED:No

In a lifetime inhalation study, exposure to 250 mg/m³ titanium dioxide dust resulted in the development of lung tumors in rats. These tumors occurred only at dust levels that overwhelmed the animals' lung clearance mechanisms and were different from common human lung tumors in both type and location. The relevance of these findings to humans is unknown. The International Agency for Research on Cancer (IARC) has classified Titanium Dioxide as possibly carcinogenic to humans (Group 2B) based on inadequate evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals.

TERATOGENICITY AND EMBRYOTOXICITY

Not available.

REPRODUCTIVE TOXICITY

Not available.

MUTAGENICITY

Not available.

TOXICOLOGICALLY SYNERGISTIC PRODUCTS

None known.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

Anesthesia, respiratory tract irritation, dermatitis, nausea, vomiting.

ADDITIONAL HEALTH INFORMATION

Not available.

===== SECTION VII - PREVENTIVE MEASURES =====

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Clean up with water before allowing to dry. Sodium Chloride can be sprinkled on the spill, which may coagulate the latex and facilitate cleaning with water. Place coagulated waste in a closed container. Flush area with water.

WASTE DISPOSAL METHOD

Reclaim or dispose of through a licensed waste disposal company according to Federal, Provincial and local regulations.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Storage: Keep from freezing. Store in a well ventilated area out of direct sunlight and away from any source of heat. Handling: Avoid prolonged or repeated inhalation of heated vapours or spray mist. Avoid prolonged or repeated skin contact. Wear adequate personal protective equipment.

OTHER PRECAUTIONS: None known.

RESPIRATORY PROTECTION

Not normally required when applying by brush or roller. When spraying, wear a mist/dust particulate respirator. In cases of poor or no ventilation, wear a respirator NIOSH approved for organic vapours and particulates.

VENTILATION

General (dilution) ventilation is required during use. Local exhaust ventilation is required during operations where this material is heated.

PROTECTIVE GLOVES

Rubber.

EYE PROTECTION

Chemical safety glasses, goggles or face shield.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT

Use impermeable aprons and protective clothing whenever possible to prevent skin contact.

WORK/HYGIENIC PRACTICES

Eye washes and safety showers in the workplace are recommended.

===== SECTION VIII - FIRST AID MEASURES =====

INHALATION OVEREXPOSURE: Move person to fresh air. If breathing stops, apply artificial respiration and seek immediate medical attention.

EYE CONTACT: Flush with water for at least 15 minutes. Seek medical attention.

SKIN CONTACT: Wash thoroughly with mild soap and water.

INGESTION: Drink 1 or 2 glasses of water to dilute. Contact a physician immediately.

===== SECTION IX - PREPARATION =====

PREPARED BY: TECHNICAL DEPARTMENT

===== SECTION X - DISCLAIMER =====

To the best of our knowledge, the information contained herein is accurate, obtained from sources believed by Cloverdale Paint Inc. to be accurate. No warranty concerning the accuracy of these sources is made and Cloverdale

Paint Inc. will not be held liable for claims relating to use of this information or recommendations.