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Endocrine-Disrupting Chemicals (EDCs) as Industrial and Settler Colonial Structures: Towards a Decolonial Feminist Approach

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Abstract

Oil refineries and settler colonialism are not typically how feminist and environmental frameworks scope the problem of endocrine-disrupting chemicals (EDCs). Instead, it is much more common to find EDCs described as a problem of packaging, plastics, and consumer goods, and to characterize their effects as a problem of bodily damage, and particularly as injuries or alterations to the reproductive and sexual development of individuals. This paper seeks to expand from these individualized, molecularized, damage-centered and body-centered frames, and to strengthen decolonial feminist frameworks for understanding EDCs. We contend that our understanding of EDCs must expand to the structures of settler colonialism and racial capitalism that accompany oil extraction and refining, as well as to the distribution of emissions to airs, waters, and lands. Building on the argument that pollution is colonialism, we hold that EDCs are materially a form of colonial environmental violence, disrupting Land/body relations, and at the same time, are made possible by a permission-to-pollute regulatory regime.

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Introduction

In winter, the cold air draws out into visible relief the smoke that flows from the stacks of Canada's seventeen oil refineries. Forty percent of Canada's petrochemical refining happens in one location in southwestern Ontario called Chemical Valley, where three refineries and some fifty other facilities are clustered (Ecojustice, 2007). Plumes are emitted into the air at a steady flow, punctuated by an almost daily interruption of leaks, flares, and spills—interruptions that are simultaneously obscured and revealed by the companies in tweet-sized accident reports and inadequate monitoring data. These refineries are just one node in a continent-spanning infrastructure in which the fossil fuel industry extends and spreads from coast to coast. The settler colonial state of Canada has built itself out of this extraction, starting with furs in the seventeenth century and then expanding to timber, fossil fuels, and mining. In turn, Canada's environmental governance is largely a permission-to-pollute system, designed to support extraction as a core economic feature of the nation (Barker, 2009; Coulthard, 2014; Murphy et al., 2019a).

The centrality of extraction in Canada is expressed by the fact that it is home to 75% of the world's mining companies (Statista, 2018), and is the world's fourth largest oil producer, supplying 43% of oil imported to the United States (Natural Resources Canada, 2018). The siting of Canada's Chemical Valley, moreover, is no accident. Located on the St. Clair River, which has been made into the dividing line between the two settler states of Canada and the United States, Chemical Valley is situated at a crucial site in the twentieth-century invention of oil-based fossil fuel capitalism, stretching from the establishment of Fordism and the industrial automotive industry in Detroit at the southern extension of the waterway to the world's first commercial oil field at the northern end. Chemical Valley sits on the traditional territory of Aamjiwnaang First Nation, and its creation began in the 1850s along with colonial processes of land theft, private property, and later, the establishment of the reserve system. Aamjiwnaang First Nation is surrounded by disruptions from Chemical Valley on all sides, including hundreds of subsurface pipelines, storage caverns for sludge and gas, as well as atmospherically in the form of pollution. The presence of over 150 years of colonial disruption is profoundly shaped by the laws and regulations of the Canadian state in the past but also in the present. For example, the emission standards for oil refineries on the Canadian side of the river are strikingly lax in comparison to those in the United States; Canadian refineries can have emission levels fifty times greater than comparable US refineries (Ecojustice, 2018). Moreover, projected levels of oil and gas industry growth coupled with lax

regulation and subpar commitments under Canada's 2030 Paris Agreement means that the oil and gas industry will account for 38% of Canada's total emissions by 2030 (Environmental Defence & Stand.Earth, 2018). The airborne emissions of such oil refineries carry a multitude of endocrine-disrupting chemicals that disrupt Lands, sovereignty, bodies, and futures.[1] Addressing this fossil-fuel-related environmental violence, we argue, is a necessary starting point of a feminist decolonial approach to understanding what endocrine-disrupting chemicals are and do.

The term *endocrine-disrupting chemicals* (EDCs) is a shorthand for a large range of substances that mimic, block, or disrupt the work of hormones ordinarily found in human and nonhuman bodies. As such, EDCs can affect metabolism and reproductive health, as well as all organ systems and gene expression. This paper is concerned with the creation of *industrially* produced substances that disrupt hormones. We draw inspiration from Theo Colborn's foundational scholarship and commitment to facilitate state and public engagement on endocrine disruption vis-à-vis industrial pollutants, such as in Colborn's early work on industrially rooted disruptions to nonhuman life in the Great Lakes (Colborn, Dumanoski & Myers, 1996). Colborn founded The Endocrine Disruptors Exchange (TEDX), an environmental non-profit, which traces EDCs to fossil fuels and industrial processes, a trajectory of research that is further exemplified in Wylie's (2018) work on EDCs and fracking. Industrial EDCs are often synthesized from fossil fuels, and released in processes of extraction, refining, production, and disposal to air, water, and land (Wylie, 2018; The Endocrine Disruption Exchange, n.d.). We build upon this link, further rooting these industrial processes in the context of settler colonialism and its relation to fossil fuel capitalism as per Indigenous environmental justice. We differentiate hormone *disrupting* chemicals—that is, chemicals that non-consensually disrupt hormones—from the consensual use of substances to alter bodies, gender expression, and reproductive health. We acknowledge that hormone-interacting chemicals have many sources, from plants to pollution to drugs, and can include both life-affirming and life-harming, consensual and non-consensual outcomes. We further find inspiration and guidance from Indigenous Land and water protectors such as Katsi Cook (Mohawk, Akwesasne First Nation) and Ada Lockridge (Anishinaabe, Aamjiwnaang First Nation), who have researched and taught about the ways EDC pollutants have disrupted communities intergenerationally on the Great Lakes (Fitzgerald et al., 1998; Hoover et al., 2012; LaDuke, 1999; Mackenzie, Lockridge & Keith, 2005). In focusing on disruption, this paper situates EDCs in industrial processes and sources, which are further understood as made possible by settler

colonialism. Thus, such industrial EDCs are material forms of colonial and capitalist violence.

Oil refineries and settler colonialism are not typically how feminist and environmental frameworks have scoped the problem of hormone disrupting chemicals.[2] In mainstream liberal environmental frameworks, it is much more common to find EDCs described as a problem of exposure from packaging, plastics, consumer goods, and foods, and to characterize their effects as a problem of bodily health and particularly as injuries or alterations to the reproductive and sexual development of individuals. The emphasis on reproductive and sexual health is reflected by the fact that this group of substances is often emphasized as disrupting estrogen- and androgen-related processes, thereby highlighting the effects to sex-associated bodily developments and processes. In Canada, popular environmental discussions about hormone-disrupting chemicals have been strongly associated with the chemical Bisphenol A (BPA) in plastic products, such as baby and water bottles. Likewise, phthalates, used to make plastics, cosmetics, and personal hygiene products, are another well-known EDC associated with everyday consumption. Flame-retardant chemicals, such as polybrominated diphenyl ethers (PBDEs), are yet a further group of industrial EDCs, likewise embedded within household consumer products such as furniture and electronics. This association of EDCs with personal consumption is further thickened with monitoring work that has documented high levels of EDC exposures indoors, particularly in homes, as the result of such consumer goods and materials (Dodson et al., 2012). The home has come to be represented as a site of concentrated EDC exposure through another culprit, house dust, which collects and concentrates pollutants (Hwang, Park, Young, & Hammock, 2008). While EDC dust research tends to focus on personal spaces, other research importantly remobilizes dust to show the extensive spread of industrial pollution into a community's living spaces, such as the innovative work done around the Chevron refinery in Richmond, California (Brody et al., 2009). The conventional framing of EDCs as primarily a concern of exposures from products at the moment of consumption or in domestic space limits public understanding of EDCs to individualized, molecularized, damage-centered, and body-centered frames.

Embracing this habitual framework, mainstream advocacy around EDCs easily slips into an individualized environmental politics that takes the form of campaigns for labeling products, education towards consumer vigilance in purchasing, or even housecleaning practices as tactics to manage these

consumption-born exposures. EDCs as limited to a consumer-based problem are apparent in Canada's regulatory regime, where the only EDC-specific regulation to date concerns the removal of BPA from consumer items used by infants. A consumer focus responds to funding-related and other pressure on mainstream environmental organizations to produce actionable, immediate interventions for the public. However, such interventions reinforce individualizing narratives of blame in relation to EDCs, such as is apparent in consumer-based activism—what Norah MacKendrick (2015) refers to as precautionary consumption. Organized through the feminization of reproductive labor, precautionary consumption places responsibility on women to purchase goods that are deemed non-toxic, natural, or organic in order to seemingly avoid toxic exposures. A signature aspect of environmental sexism is women's disproportionate labor in managing environmental harms (Voyles, 2015). While precautionary consumption is common in popular environmental health discourses, it is flawed. It assumes that boundaries can be established between people and their environments, and erases the fact that toxics are ubiquitous in our surroundings (Endocrine Disruptors Action Group, 2016; MacKendrick, 2015; Scott, Haw, & Lee, 2016; Scott & Lewis, 2015).

EDCs in consumer products always come from somewhere. That is, they can be traced back through the chain of production to their manufacture and a larger disbursement of environmental violence. Hence, EDCs operate as built-in exposures (Endocrine Disruptors Action Group, 2016)—industrial chemicals knowingly added to commodities, often as a means to turn the waste products of fossil fuel refining into profit-making chemical feedstocks to be inserted into marketable products. Petrochemical manufacturers know that hormone-disrupting substances, such as flame-retardant chemicals or plastic-softening phthalates, create harm and yet nonetheless continue to sell and distribute them. Moreover, industrial chemicals as wastes and pollution are knowingly put into air, water, lands, and bodies as a "free" form of disposal for companies. The ubiquity of EDCs in air and water pollution makes individual avoidance of EDCs in a pervasively polluted world impossible. Precautionary consumption advocates for individual responses to structural issues—what Alexis Shotwell (2016) calls healthism—and is only accessible to those with economic means, presenting avoidance of exposure as a matrix of morality and choice. Indigenous communities cannot individually avoid being affected by colonialism and Black communities cannot merely avoid the encompassing surround of anti-blackness. Consistent with neoliberal individualization, healthism absolves the state of its responsibilities to regulate harmful toxicants, erases structural violence, and

places the burden of responsibility and blame on often feminized labor (MacKendrick, 2014; Scott et al., 2016; Scott & Lewis, 2015; Shotwell, 2016). Precautionary consumption thus perpetuates injustice rather than mitigates it. Even as the aim of precautionary consumption is to limit EDC and other toxic exposures, the approach erases and deflects responsibility for exposures that are fundamentally made possible by fossil fuel capitalism and settler colonialism.

This paper seeks to contribute to the disruption of this heteronormative domesticated understanding of EDCs and to strengthen decolonial feminist frameworks for understanding EDCs as manifestations of structural violence in unevenly polluted worlds. We might begin this reframing by noting that phthalates are petrochemicals, manufactured through either the feedstock chemicals of naphthalene or orthoxylene that are derived from oil refining. BPA, too, is derived from petroleum, and its very use is premised on the need to make other petroleum-based epoxy resins and plastics more pliable. This paper's understanding of EDCs joins other researchers in pushing the study of EDCs back to fossil fuel and petrochemical industry production, and thus also extends out to extraction itself, including oil fields, fracking pads, mining pits, and tar sands (Bolden et al., 2018; Bolden et al., 2015; Gómez-Barris, 2017; Kassotis et al., 2016; Kassotis et al., 2015; Kim et al., 2016; Endocrine Disruption Exchange, n.d.; Truter et al., 2016; Wylie, 2018). This understanding of EDCs also expands to the wastelanding practices of settler colonialism and racial capitalism that accompany oil extraction and refining performed through the distribution of industrial and infrastructural emissions to airs, waters, and lands.[3] In this paper, we join other environmental justice researchers to take up this challenge of highlighting the industrial and extractive sources of EDCs, as well as to add an emphasis on the work of settler colonialism in the structures that underlay this modality of environmental violence. Each refinery, each factory, each pipeline in Canada and the United States is on the traditional territory of specific Indigenous nations and is made possible by a history of land theft and genocide, as well as ongoing colonialism. We end by presenting our collaborative work on the *The Land and the Refinery: Past, Present, and Future* as an example of developing a decolonial feminist approach to EDCs (Murphy et al., 2019a).

In reaching towards a decolonial feminist approach to environmental violence, resituating EDCs as industrial chemicals is not enough. We argue that it is crucial to also question the very habits of framing EDC harms primarily in terms of sex- and body-based damage. A decolonial feminist approach to EDCs cannot be satisfied with the individualized body-based frame and heteronormative mode of

much research on EDCs. Guided by Eve Tuck's (2009) prompt to suspend damage-centered research that extracts findings from the lives of Indigenous and other over-researched communities, we refute body-centric narratives of harm that reduce people to "damaged bodies" and imply harm as an individualized *event*. This mode conceals broader infrastructures and relations—*structures* of violence (Murphy, 2017; Wolfe, 1999). To refute extractive body-centric approaches is a methodological commitment that interrogates violence at its source, rather than at its, albeit important, manifestations of pain, loss, and harm.

As a collaboration between a non-Indigenous South Asian diasporic scholar and an Indigenous Métis scholar, we draw on multiple itineraries to inform our decolonial feminism, shaped by different, sometimes conflicting, histories of occupation and complicity.[4] As our work in this paper highlights chemical violence on Anishinaabek Land and with specific relation to Aamjiwnaang First Nation as well as the broader lower Great Lakes basin that is also governed by Haudenosaunee laws, we frame our approach primarily through engagements with Indigenous decolonial feminist frameworks from that territory. We also build on feminist and queer studies scholars who have pushed back on the heteronormative sex panics that scientific and media accounts of EDCs have tended to promote (Ah-King & Hayward, 2013; Di Chiro, 2010; Shotwell, 2016). Likewise, we learn from feminist science and technology studies (STS) scholarship that has importantly attended to the ways scientific practices in toxicology and evidentiary practices in toxic governance have been sites of struggle involving industries and research scientists around the legitimacy of hormone disruptor research, and especially the validity of low dose effects (Hayes, 2011; Cordner, 2016; Vogel, 2012; Wylie, 2018). In Europe, such struggles have erupted into the news as scientists denounced the role of industry representatives in the creation of new EDC standards for the EU (Kortenkamp et al., 2016), while in Canada and the US, critical work has shown the role of industrial lobbies in promoting flame-retardant EDCs (Endocrine Disruptors Action Group, 2016). Thus, in addition to reframing EDCs as industrial chemicals, we also argue for an approach that positions such violence as the structural and extensive reach of settler colonialism and racial capitalism through both corporate pollution and setter state regulation into Land/body relations. We learn from and contribute to Indigenous feminist theorizations of environmental violence as constituted through settler colonialism, extraction, and experiences of community-based, body-based and particularly gendered, sexual, and intergenerational harms (Carmen & Waghiyi, 2012; Native Youth Sexual Health Network & Women's Earth Alliance, 2016). Following this work, we argue that violence through fossil-fuel-related EDCs is violence on the Land is violence on our bodies.

Beyond Body-Centric Narratives

Closely attending to EDCs can teach us to disturb many of the pernicious habits by which chemical violence is conventionally represented. Building on the argument that pollution is colonialism, we hold that EDCs in Canada and the United States are materially a form of colonial environmental violence, disrupting Land/body relations, and at the same time, are made possible by a permission-to-pollute regulatory regime. This regulatory regime emphasizes outdated "dose makes the poison" approaches to toxicity, erasing not only low-dose effects, but also intergenerational effects, cumulative effects, as well as concentrated effects that expose Indigenous, Black, Brown, and poor communities to early mortality, intensified debility, and reproductive violence. Because EDCs can have some of their most injurious effects at low levels, the structural allowance of such exposures using a "dose makes the poison" logic is particularly pernicious in the context of chronic, persistent, and cumulative exposures borne by frontline communities and those occupationally exposed to petrochemical facilities. As developed by Métis scholar Max Liboiron, as well as our collaborative work in the Endocrine Disruptors Action Group, the *pollution is colonialism* framework attends to how Land, in all its relations and not just as territory, is turned by colonial logics into a resource to be extracted and a *terra nullius* (empty space) dumping ground for waste (Endocrine Disruptors Action Group & the Civic Laboratory for Environmental Action Research, 2017; Liboiron, 2019; McKittrick, 2013; Voyles, 2015). This framework understands Land in an extensive sense; Land is composed of earths that carry histories, ancestors, and future generations; stones that are grandfathers; waters as a living being; and many animals and plants that human communities have longstanding agreements with and responsibilities towards (McGregor, 2009, 2018; Betasamosake Simpson, 2014; Hill, 2017). This sense of Land stretches forward and backward in time, and is importantly reproductive. That is, it understands that communities and humans are made of and through Land; they are themselves a manifestation of Land.

Industrial EDCs can teach us about the structural injustices built into permission-to-pollute regulatory systems and these Land/body relations. Such EDCs, which interfere in the conduct of hormonal systems and even gene expression, are notable for their disruptions to developing fetuses, pregnancy, infancy, or any other window of life when people are in intensified development and alteration, requiring us to attend to the distribution of life changes and exposure to injury by life stage. The widespread ubiquity of industrial EDCs, on the one hand, and their intensification for frontline communities, on the other, make hormonal disruption

a profoundly expansive and yet uneven condition for people living and surviving in the hostilities that have been built into the world by racial capitalism and colonialism. Yet it is crucial to keep in mind that the effect of EDCs goes beyond these reproductive, life course, and sex-related disruptions to include neurological, cardiovascular, immune, and other effects (Shug, Janesick, Blumberg, & Heindel, 2011; Su, 2016; Waye & Trudeau, 2011). The roles of hormones extend beyond those areas of the body we dominantly signify as reproductive or sexed. Further, some EDCs are linked to cancer (National Institute of Environmental Health Sciences, 2018). For example, a 2012 multi-year study, "Breast Cancer Risk in Relation to Occupations with Exposure to Carcinogens and Endocrine Disruptors: A Canadian Case–Control Study," found suggestive links between occupational exposures to carcinogens and EDCs and an elevated risk of breast cancer in the area around Aamjiwnaang (Brophy et al., 2012). This finding is consistent with other occupational studies, which have repeatedly pointed to heightened cancer risk as a result of EDC exposures (Iavicoli, Fontana, & Bergamaschi, 2009; Villeneuve et al., 2010). Aamjiwnaang First Nation has a well known skewed sex ratio of twice as many babies born with female- versus male-identified genitalia, while widespread interference in sexual development has been documented in birds, fish, and reptiles in the region (Mackenzie, Lockridge, & Keith, 2005; Marentette et al., 2010; de Solla, Bishop, & Brooks, 2002). Thus, the injustices built into the regulatory system express themselves through EDCs as particular sexed and gendered effects, and at the same time, as pernicious effects altering many aspects of bodily being, including cognition and exposure to early death.[5]

The violence of EDCs is not only widely extensive and unevenly intensive across communities and Land/body relations; it is also expansive in time. EDCs are associated with intergenerational impacts that manifest in later generations (Endocrine Disruptors Action Group, 2016; Wolstenholme et al., 2012).[6] The intergenerational scope of chemical violence can happen in a multitude of ways. First, because EDCs can have particularly strong effects on developing fetuses, exposures while pregnant can include consequences for not only the person exposed but their future child, and the gametes of that future child, hence their grandchildren.[7] Second, some EDCs have harmful epigenetic effects, some of which are inheritable, and thus can be passed on as metabolic susceptibilities to future generations beyond three generations. Third, disruption to reproduction and the loss of community members to death can have long-lasting effects to communities' well-being emotionally, spiritually, culturally, and materially. Fourth, EDCs, through their persistence in water and soil, or through their effects

on and accumulations in animals and plants, disrupt the ability of communities to maintain kinship and obligations to Land, food, and nonhumans. There is a robust body of literature on the impact of EDC exposure on nonhuman life (Colborn & Clement, 1992; Hayes et al., 2002; Hoover, 2013; Sapouckey et al., 2018). Thus, EDCs manifest the ways pollution is not just a harm in the moment but part of ongoing violence that stretches across generations, across communities, and across Land. EDCs have not only intergenerational effects to human descendants but also place-based disruptions to relations to Land and nonhuman relations.

As an alternative to focusing primarily on the body, we draw on the concept of distributed reproduction to theorize and create actionable interventions to limit exposures to industrial EDCs. Distributed reproduction names an understanding of reproduction occurring beyond bodies within uneven spatial and temporal infrastructures and relations. This conception of reproduction acknowledges the fulsomeness of Land/body relations, understanding reproduction to exceed the individual body as the site of childbirth and extends into relations to Land. It also attends to the reproductive work of settler infrastructures that distribute the benefits and violences of capitalism and colonialism in particular ways, reproducing and privileging capitalist relations to Land and life (Murphy, 2013). Settler colonial infrastructures are always in disruptive relations to Land in the fulsome sense of all our relations and Indigenous sovereignty. Within the settler colonial infrastructures of the oil and gas industry—which includes both the corporate industrial structures and the state's permission-to-pollute system of regulation—white, settler, and capitalist forms of life are promoted, and other forms of life, Land, and sovereignty are disrupted. Through settler infrastructures, particular ways of accumulating benefits for the settler state persist that depend on the ongoing disruption and negation of Indigenous sovereignty and devaluation of Indigenous, Black, racialized, and poor communities, as well as the nonhuman communities which are present in places of intensive pollution. Thus, disrupted Land and colonial infrastructures also become part of our Land/body relations as our lives are formed in part through this violence. Yet despite this infrastructural violence, Land and Indigenous sovereignty persists and is valued (Murphy 2013). In theorizing distributed reproduction in this way, we draw on the concept of reproductive justice, as crafted by women-of-color feminists in the United States (Forward Together, 2018; INCITE! Women of Color Against Violence, 2006; Ross, 2017; Ross & Solinger, 2017; SisterSong, n.d.); the Comilla Declaration of 1989, written in Bangladesh, which theorizes the engineering of life in both agriculture and in human bodies as connected forms of the relations of reproduction; Marxist feminist work that theorizes the structuration of

reproduction as pivotal to capitalism; Indigenous feminisms that attend to the intergenerational reverberations of violence and the continuance of colonialism, as well as understandings of Land as the wellspring of being, responsibility, and law; and queer studies work that questions heteronormativity within ways of envisioning futures. We further draw on environmental justice praxis, which identifies the systems and processes that render some life polluted, and therefore, expendable—or conversely, some life as expendable, and therefore, pollutable. The 1984 Union Carbide/Dow Chemical disaster in Old Bhopal, India, has occupied a central place in our conception of environmental injustice. The subsequent multigenerational and multifaceted movement for justice is another important location in which community struggle has conveyed the logics of distributed reproduction. As the movement holds states and companies responsible for the ways some life is violated, altered, and abandoned, there is a simultaneous community-based push to reproduce hopeful futures (Fortun, 2001; Hanna, Morehouse, & Sarangi, 2005). Following this path of theorizing, we call for a conceptualization of EDCs not merely as a class of chemicals but as a structural relation of violence that manifests the intergenerational, Land-based, and targeted violences of settler colonialism, racial capitalism, heteropatriarchy, and fossil fuel extraction. As Liboiron, Tironi, and Calvillo (2018) assert, "Structures define toxicity." (p. 333).

This sense of distributed reproduction helps us to highlight both the reproduction of structures, including the burdens of chemical violence that are reproduced in frontline and occupationally exposed communities, and the Land/body relations of life support that communities create and are responsible to. It builds on the work of Tonawanda Seneca feminist scholar Mishuana Goeman (2017), who has called for attention to the ways "gendered and sexualized violence has multiple connections that spread out on vertical and horizontal scales" (p. 100). As such, distributed reproduction is layered. It points to the intergenerational and transgenerational burdens of EDCs, which target Indigenous, Black, racialized, feminized, queer, trans, Two-Spirit, and poor communities who often live proximate to intensive industry and extraction, and at the same time, points to the intergenerational settler project of technologically and legally building infrastructures of extraction and Indigenous elimination. It points to the extensive life supports that we, as communities, maintain and create to make up our Land/body relations, and it points to their disruption by systems that benefit the settler/racist state. When we relegate EDCs to harm at the molecular level (as is the disciplinary focus of many biomedical studies), we erase the broader structures of violence that reproduce cross-generationally, as well as the various

incarnations of harm that occur on a collective level (see Liboiron et al., 2018; Scott et al., 2015). This is not to minimize the harms experienced on an individual level. Rather, the aim is to link these harms to the broader structures that underlie and perpetuate them, as well as to understand the interconnectedness of body, Land, and structures of power. This conceptualization, in turn, puts the representational burden for violence on polluters, and the broader permission-to-pollute system that allows these harms to persist. In contrast, body-centric narratives highlight the harms and the victims of harm, but decenter the perpetrators of that harm. By refocusing our attention to the perpetrators of harm, new possibilities of action become clear—beyond individualized and consumer-based approaches that stem from body-centric narratives. To address the violence of EDCs, it is necessary to theorize structurally, in infrastructures, as well as decolonially, through Land/body relations. To live with and against the violence of settler colonialism and racial capitalism, it is also necessary to foster and support affirming forms of distributed reproduction that uphold communities, defend Land, and respect Land/body sovereignties.

EDCs as Structure, Not an Event

While toxics do not discriminate, settler colonial systems do. As such, EDCs have disproportionate and targeted impacts, including heightened rates of breast cancer amongst women in the automotive plastics industry (Brophy et al., 2012), and a myriad of harms in frontline communities, such as Aamjiwnaang First Nation, on whose Land Chemical Valley, including three of Canada's biggest refineries, sits. In short, chemical violences have "disproportionate impacts, concentrated by Indigeneity, race, gender, class and age, that result from exposures to environmental toxicants and the processes of industrial development" (Endocrine Disruptors Action Group, 2016, p. 19). These uneven exposures are rooted in broader structures and must be approached as such, rather than via the individualizing accounts of body-centric and molecular-level harm. At the same time, EDCs exceed this targeted and concentrated violence. They flow through waterways, are transported on air currents, bounce up or down to the poles, and move through commodities. The structural violence of EDCs is thus both concentrated and overflows to become widespread.

This shift in understanding to the structuration and overflow of pollutants is reflected in recent environmental justice scholarship, which affirms the embeddedness and interconnectedness of bodies, environments, and structures or power through transcorporeality (Alaimo 2010, 2016) or corporeal citizenship (Gabrielson & Parady, 2010).[8] This is a departure from earlier conceptions of

environmental injustice, which, as Laura Pulido (2015) notes, lacked a root cause analysis by focusing on acts of individualized and deliberate harm as well as the effects of that violence on Black, Brown, Indigenous, and poor communities. More recently, Pulido (2016a, 2016b) uses Cedric Robinson's (1983) racial capitalism to denote racism and white supremacy as fundamental to capitalism, which, alongside settler colonialism, is at the root of environmental injustice. Racial capitalism and settler colonialism are structures, not events (Wolfe, 1999, 2006; Kauanui, 2016). That is, they are ongoing projects that are extensive spatially, present in mundane institutions, actions, and logics, and reproduce over time from the past to the future. Settler colonialism, moreover, is a land-centered project with a temporal aim, operating by eliminating and replacing Indigenous life and governance. Settler colonialism and racial capitalism, which simultaneously arrange life in Canada and the US, are interconnected through shared histories and regimes of whiteness, property, exploitation, and extraction. These structures help to order distributed reproduction in that they both strive to arrange which beings, life supports, and relations are supported and persist, and which are open to be disappeared, wasted, or replaced. EDCs, then, run through and reinforce these structures.

Gender is a further relation at work in this structural understanding of environmental violence, and has received renewed attention in environmental justice scholarship, following earlier approaches that glossed over gendered environmental injustices, or detached gendered injustices from broader structures of power. The renewed approach to gender in environmental justice is reflected in Dayna Nadine Scott's (2015) feminist political economy of pollution. This approach "interrogates systematic issues of power and ownership relating to the question of who profits from and exerts exploitative control over ecological resources, economic capital, and social labour" (p. 5). The super-exploitation of women is fundamental to this question, including the disproportionate burdens of bearing and managing toxic exposures (Scott et al., 2015). Indigenous feminist theorizations further point to gendered harms, such as in the conception of environmental violence as an explicitly gendered term. First defined by Carmen and Waghiyi (2012), environmental violence refers to the disproportionate impacts of chemical violence on Indigenous women. Building upon this initial framing, the Native Youth Sexual Health Network and Women's Earth Alliance (2016) define environmental violence as "the disproportionate and often devastating impacts that the conscious and deliberate proliferation of environmental toxins and industrial development (including extraction, production, export and release) have on Indigenous women, children and future

generations, without regard from States or corporations for their severe and ongoing harm" (p. 15). The Canadian National Inquiry into Missing and Murdered Women and Girls (2019) also highlighted the coupling of extraction economies with the intensification of sexual violence against Indigenous communities. Indigenous feminists from around the lower Great Lakes, such as Mishuana Goeman, Leanne Betasamosake Simpson, Elizabeth Hoover, Audra Simpson, Katsi Cook, and others all emphasize not only how colonial environmental violence intensifies through gender, but also how gender has been crucial to Indigenous resurgence. As Goeman (2017) argues,

> the bodies of Native women are dangerous because they produce knowledge and demand accountability, whether at the scale of their individual bodily integrity, of their communities' ability to remain on their bodies of land and water, or as citizens of their nations. The sites of these "meeting places" and scales of geographies are key to contesting colonial structures that limit spatial alternatives and thus continue to create spatial injustices. (p. 123)

The targeted, multiscalar, gendered, and disproportionate harms that industrial EDCs perform are not a chance or exceptional occurrence. In resonance with our understanding of distributed reproduction, Liborion et al. (2018) describe a structural understanding of toxicity as "*the contravention of order at one scale and the reproduction of order at another*" (p. 335). We take up this insight to argue that uneven and multiscaled Land/body exposures to industrial EDCs and other toxicants cause bodily disruptions to health and other adverse impacts, but also maintain settler colonialism, racial capitalism, and the gendered economy of pollution. The reproduction of these colonial and industrial systems is dependent on the intergenerational reproduction of disproportionate and targeted violences, including chemical violences, with beneficiaries to the white settler state and multinational companies. This violence is not an outlier or unintended consequence, nor a sign of a broken system; rather, it is part and parcel of a structure invested in the maintenance of colonialism, whiteness, capitalism, and heteropatriarchy. It is not only that EDCs are built into products; they are built into settler colonialism itself.

Representing Harm, Shutting Down Heteronormative Panic and Stigma

In moving towards a decolonial feminist approach to EDCs, we also share a concern with much of the critical feminist and queer studies scholarship that has sought ways to critique and offer alternatives to the sex panic and stigma that is

so often baked into scientific studies of the sex-related effects of EDCs. Biomedical research on sex-related effects is picked up by the media and translated into alarms over the "feminization" and "chemical castration" of males and the reinforcement of ableist conceptions of "normative bodies." For example, the notable CBC documentary *The Disappearing Male* begins with a striking announcement: "Sounds like a B movie—'Millions of males vanish!' Fact is, there aren't as many nowadays. Not human males, not frogs, not fish…From toys to shampoo, we're awash in strange new compounds, and we're only just learning that males are being hit hardest" (Doc Zone, 2008). Just as industrial EDCs operate in, reproduce, and manifest broader structures of power, oppression, and exploitation, popular approaches to combating EDCs likewise reproduce exclusionary narratives that designate some life as worth living, and others as "damaged" or sub-human. While the harms of non-consensual exposure to EDCs are intensely lived, they are often contorted by heteronormative damage-based research concerned with both nonhumans and humans alike, instigating feminist and queer scholars to craft alternative frameworks that do not activate pathologizations of intersex, queer, and trans life. In *Against Purity: Living Ethically in Compromised Times*, Alexis Shotwell (2016) notes that EDCs are presented as disruptions to a state of bodily purity and naturalness—a state that is imagined and impossible. Rather than strive for "purity politics," Shotwell (2016) argues that it is necessary to engage with the complexities of our lived-realities, including our exposures to EDCs. Similarly, scholars such as Malin Ah-King and Eva Hayward (2013) respond by arguing that sex is not a stagnant concept, but, rather, an ongoing process that is, in part, influenced by EDCs as well as many other relations. This scholarship concurs that the focus on "normative" bodies reproduces anti-queer, heterosexist, and ableist narratives (Ah-King & Hayward, 2013; Clare, 2017; Di Chiro, 2010; Shotwell, 2016). It locates harm as disruption to an imagined gender binary, which erases the multiple responses to EDCs within and across different bodies. It also reframes the embodied experiences and pains of disrupted bodily development and fertility as primarily a problem of the gender binary. Drawing on crip theory, such work emphasizes the ways that all bodies become themselves in chemical relations. Undoing the stigmatization of these effects thus becomes a way of mitigating the violence of toxic exposures.

As another way to mitigate this pervasive heteronormative panic, scholars have called for a focus on harm, rather than bodily difference (Shotwell, 2016; Scott, 2009). As Ah-King and Hayward (2013) rightly ask, "Why is sex more central than cancer, auto-immune disease, and even death? What cultural nerves (many of which are globalized), are triggered?" (p. 4). In this way, some scholarly

interventions reject EDC-associated heteronormativity by redirecting attention to the non-sexed harms associated with EDC exposure. While Scott (2009) advocates for a harm-based (rather than a difference-based) approach in relation to increases in female offspring and suspected sex-specific miscarriages in Aamjiwnaang First Nation, she articulates that harm cannot be viewed as separate from settler colonialism. Indigenous feminist scholarship, emphasizing Land/body relations (rather than chemical/body relations) moves us even closer to a decolonial framework for understanding EDCs. A notable example of scholarship that offers an expansive, more-than-body understanding of harm is the work of Mohawk scholar Elizabeth Hoover (2017), who drew from and develops Katsi Cook's framing of environmental reproductive justice (ERJ). ERJ identifies harms as collective and relational, "not just a collection of individual bodies, but as social bodies" (Hoover, 2017, p. 4). ERJ points to the collective harms that stem from chemical violence that disproportionately impacts Indigenous communities, lands, as well as nonhuman kin. These harms cause disruptions to social and cultural reproduction, which has extended intergenerational impacts. Hoover et al. (2012) expand,

> In addition to concerns about the physical reproduction of community members, indigenous people are concerned about how environmental contamination impacts the reproduction of cultural knowledge…At Akwesasne, community members report a loss of language and culture around subsistence activities like fishing, which have been largely abandoned because of fears of exposure to contaminants. The generational reproduction of culturally informed interpersonal relationships has been affected as much as physical reproduction…For many indigenous communities, to reproduce culturally informed citizens requires a clean environment. (p. 1648)

This Indigenous Land/body understanding foregrounds environmental violence and injustice as the disruption of relationships and responsibilities (McGregor, 2009), which maintain "collective continuance" (as per Whyte, 2014) and "mutual flourishing" (as per Kimmerer, 2013). As we utilize ERJ to understand the declining sex ratio in Aamjiwnaang First Nation—bordered on three sides by Canada's Chemical Valley—lowered male birth rates are linked to broader concerns of cultural continuity. Scott (2009) writes, "As one band member has stated: 'our daughters will have to go outside our community for their partners.' The concern is essentially one about cultural survival" (p. 251). In *Violence on the Land, Violence on our Bodies: Building an Indigenous Response to Environmental Violence*, the Native Youth Sexual Health Network and Women's Earth Alliance (2016) refer to disproportionate toxic exposures as a "modern form of sterilization" (p. 46). EDCs

are thus material forms of gendered and heterosexualized colonial violence, reflecting centuries of reproductive injustice via colonization that extends to both Land and bodies.

In learning from these varied critical reframings of harm, we remain cautious about reproducing an analytical framework that remains focused on damage, rather than on violence. In reaching for a decolonial feminist approach to EDCs, then, we take seriously the call by Unangax scholar Eve Tuck (2009) to "suspend damage," a call for researchers to discontinue research approaches that document the deficits and suffering of Indigenous communities, but also all other oppressed and highly extracted-from communities. As environmental justice scholars, we have seen over and over how the permission-to-pollute state does not change when confronted with the evidence of injury. Instead, communities are left with the burden of representing environmental violence through their very lives. Tuck's (2009) work echoes the politics of refusal by other Indigenous scholars who reject the extractive nature of so much academic research (Hoover, 2016; Simpson, 2007). Tuck suggests that a desire-based approach to research by and for communities has a better chance of bringing forth the world one wants to live in. But this does not mean avoiding the study of violence. Instead, a decolonial feminist approach to EDCs must ask how it can study violence without reproducing harm. How can it put the burden of representing and responding to environmental violence on the perpetrators and structures—refineries, companies, states, laws, financialization—rather than those most affected?

This question of how to suspend damage-based approaches fundamentally animates our research in *The Land and the Refinery: Past, Present, and Future* (Murphy et al., 2019a).

Reaching toward a Decolonial Feminist Approach to EDCs in *The Land and Refinery Project*

The Land and the Refinery: Past, Present, and Future is a project led by Vanessa Gray (Anishinaabe, Aamjiwnaang First Nation) and Michelle Murphy (Winnipeg Métis), co-created with Kristen Bos (urban Métis) and Reena Shadaan, and housed in the Technoscience Research Unit (TRU, University of Toronto). This project seeks to visually and informationally attach responsibility for environmental violence to corporations, with our initial focus being on the Imperial Oil Refinery in Sarnia, Ontario, located in Canada's Chemical Valley on traditional Anishinaabek land, and the specific territory of Aamjiwnaang First Nation. Imperial Oil's Sarnia

refinery was first built in 1871, making it one of the oldest refineries in North America, mirroring the history of Canada as a settler colonial state and the rise of oil-based fossil fuel capitalism. Our research team is an Indigenous-led collective, housed in an Indigenous-led lab, and comprised of Indigenous and people of color members, whose research "subjects" are the settler state, Imperial Oil, and the fossil fuel industry broadly. We understand our work to learn from and contribute to Indigenous STS, as well as decolonial feminist STS. Through our work, we aim to implicate the settler state, as well as the refinery and its multinational owner, ExxonMobil, as complicit in this violence. One element of this project is an extensive database we have constructed to link polluters to pollution to pollution-related health harms, which manifests in a mobile application called Pollution Reporter. Pollution Reporter aims to share information about health harms and emissions that is often inaccessible to Aamjiwnaang and other affected communities, and in so doing, hopes to support the communities' sovereignty to care for Land and their abilities to link environmental violence to companies without having to transit research through their own suffering. The mobile app arranges its research to attach responsibility for health harms caused by pollutants to the refinery and the state. *The Land and the Refinery* project, including the app design, is created to refute exploitative practices of data extraction that manifest colonial logics of expropriation, logics that are even present in environmental and health data that seeks to contribute to the amelioration of pollution (Murphy et al., 2019b).

This project is further rooted in the knowledge that Canada's toxics regulation is fundamentally flawed, as the state is complicit in a permission-to-pollute system. Loopholes in regulations are, we argue, not an unintended consequence, but rather built into the regulatory regime to allow pollution to a certain level.[9] Through stories and research on *The Land and the Refinery: Past, Present, and Future* website, the project provides a textual and visual testimony of the permission-to-pollute system in Canada, placing obligations for violent actions on both the company and the state. This consideration is fundamental to the project, which requires shifts in gaze—from individualized, body-centric, and damage-centric narratives to the perpetrators of harm and the conditions of settler colonialism from which they are rooted.

The database that the Pollution Reporter app draws on also seeks to reflect our understanding of EDCs and their relation to a colonial permission-to-pollute system (Murphy et al., 2019b). To make the database we had to critically analyze

available company- and state- produced data about pollution in Chemical Valley. The app's database draws on the National Pollutants Release Inventory (NPRI)—a useful but fundamentally flawed nationally used method to report emissions. Under the NPRI, which functions much like the US-based Toxics Release Inventory, facilities are required to provide annual emissions data for 324 chemicals to the federal government, which is then made publicly available. This is useful because it is rare source of data that directly attaches emissions to facilities in an area such as Chemical Valley, where there is a concentration of some fifty facilities concerned with petrochemicals. Other publicly available pollution data, primarily in the form of limited air monitoring, provides information that cannot be tied back to a specific facility. However, the NPRI is flawed. It is based on industry self-reported emissions data, which is often produced through indirect methods (calculative estimations generated by software or spreadsheets), with no actual physical measure of pollution. In addition, companies only have to report releases when they exceed a certain level, often measuring at the scale of a ton. Thus, NPRI data simultaneously reveals and obscures environmental violence. However, as a component of the permission-to-pollute regulatory system in Canada, the NPRI is nonetheless an admission to some kinds of environmental violence (Murphy et al., 2019b).

Our approach is to thicken this "bad" data with responsibilities and relations. We use the data as evidence of the permission-to-pollute state, as well as testimony of acts of violence. We also connect the data to the colonial history of the refinery, which occupies Anishinaabek Land, and particularly that of Aamjiwnaang First Nation. Through this historical work, we situate the refinery's pollution within a history of colonial disruption to Indigenous Land/body sovereignties. Additionally, and crucial to this paper, the database connects peer-reviewed studies about health effects to the chemical releases the refinery admits to. We attach responsibility for those health effects to their creator, Imperial Oil, its majority owner, ExxonMobil, as well as to the Canadian state, which allows these emissions to occur. The data in Pollution Reporter is a visual testament to the colonial violence of Imperial Oil, which is intergenerational, distributed, persistent, and cumulative, reflecting extensive violence that targets present and future life and thus disrupts community and relations to Land (Murphy et al., 2019b).

This project is ongoing and builds on decades of work by the Aamjiwnaang community on Chemical Valley (Luginaah, Smith, & Lockridge, 2010; Mackenzie,

Lockridge, & Keith, 2005). What is different about this project is its approach. While much past work has documented harms to the community in order to show the violence of Chemical Valley, *The Land and the Refinery* is an Indigenous-led project, responsible to community, that seeks to critically study and obligate a settler colonial company and contribute to less-disrupted futures. In this way, we seek to suspend damage and activate desire-based frameworks, as well as respect and activate Indigenous jurisdiction, Land/body sovereignty, and decolonial futures. In doing this work, we have proceeded with permissions from Chief and Council as well as the Aamjiwnaang First Nation Environmental Committee and community consultation. The app and website are primarily made for Aamjiwnaang, even as they are public. The project is co-led by Vanessa Gray, community Land Defender, and we also collaborate with community members in the theorization and creation of this project through community events, with the understanding that this work is in service to Aamjiwnaang and other frontline communities. Importantly, we situate the pollution as a disruption that goes back to 1871, which is a long time ago, but in the context of long histories of pre-colonial Anishinaabek presence and Land relations, is also a short time ago. We remember the time and generations before Chemical Valley, and we also know there will be a time after Chemical Valley that we are also responsible to. Lastly, we honor that polluted Land is still sacred. Disrupted Land and life is valued and cared for.

This work of activating relations, responsibilities, and histories has helped us to develop this paper's decolonial feminist approach to EDCs. Through NPRI-housed industry self-reported data, the Sarnia Imperial Oil Refinery admits to releasing 76 different chemicals and chemical categories. Of these 76, at least 59 are potential EDCs. Of the 59, at least 21 chemicals have strong research evidence of hormone disruption. These EDCs are amongst toxicants that produce respiratory, cancer-related, reproductive, neurological, eye- and skin-related, cardiovascular, liver, kidney, and blood-related, gastrointestinal, and immunological harms to life. In addition, many are harmful at low levels, have intergenerational and subclinical effects, as well as persist in Land and human and nonhuman life—health outcomes that are often lesser acknowledged in state, industry, and disciplinary toxicological databases about chemical harms. Our data draws on state-produced and scientific sources that connect toxics to individualized and body-centric manifestations of violence; yet, presented in this database and explicitly rooted in the perpetrators of violence, the data collectively demonstrates cumulative colonial violence and community persistence, past, present, and future.

In explicating the permission-to-pollute system, we have found that emergent scientific research on EDCs is underutilized by the state, which results in risk assessment and regulatory measures that do not adequately address toxic exposures and the extent of their impacts. Moreover, another level of erasure of the violence of industrial EDCs is accomplished by the state's determination of toxicity based on designating thresholds of exposure, which profoundly shapes the risk assessments of chemicals under the Canadian Environmental Protection Act, 1999, as well as through Ontario's Ambient Air Quality Criteria, Ontario's occupational exposure limits, and the non-binding Canadian Ambient Air Quality Standards. Threshold-based regulation allow certain amounts of a substance to be released into the environment under the assumption that low-level exposure to various toxicants do not produce adverse impacts. This is an outdated approach, inconsistent with toxicological findings, particularly in relation to EDCs and low-level impacts in general (see Lanphear, 2017; Vandenberg et al., 2012). Further, the state's regulatory approach ignores the impacts of cumulative and chronic exposures, including exposures to multiple EDCs, such as those emitted by the Imperial Oil refinery and its neighboring facilities on a daily basis. In addition, pollutants that are not deemed bioaccumulative or persistent can become persistent by virtue of our constant exposure to them (Shapiro, 2019). Accordingly, thresholds, we argue, are an ineffective method for holding companies responsible for their toxic exposures, particularly in frontline communities adjacent to industrial and polluting activities, and amongst workers in those facilities. Thresholds are, in effect, an additional manifestation of Canada's permission-to-pollute system.[10]

This approach to EDCs understands itself to be a testament to not only corporate and state colonial violence but the ways pollution itself is part of broken treaties. Our research documents the ways land theft and the imposition of private property made Chemical Valley possible. The project aspires to make pollution and ourselves responsible to ongoing treaties, such as the One Dish and One Spoon Wampum Covenant that dates back to before colonialism and is a recurring form of agreement with and between Haudensaunee and Anishinaabe Confederacies to care for and live on the lower Great Lakes peaceably and without taking more than is needed. We also seek to activate the Two-Row Wampum Covenant, the first European-Indigenous treaty of the region (between Dutch and Haudenosaunee) that calls for colonial inhabitants to not interfere through their actions in Indigenous sovereignties and lifeways. Thus, the permission-to-pollute system is a constituent element in the ongoing violation of these agreements that

The Land and the Refinery project seeks to uphold (Murphy et al., 2019a).

In addition to serving community, the Pollution Reporter app aims to demonstrate and make actionable the central argument in this paper, that EDCs are pervasive in refining, enact intergenerational violence, and disrupt Land/body sovereignties. To date, most toxicological research on EDCs has focused on dermal and oral exposures, with exposure via inhalation from airborne emissions as a relatively recent research focus (Darbre, 2018). Airborne EDCs are a particular concern in relation to extractive and polluting industries, which reproduce the targeted, disproportionate, and intergenerational violences of settler colonialism, racial capitalism, and the gendered economy of pollution. Through a decolonial feminist distributed reproduction lens, pollutant EDCs represent the reproduction of these broader processes, in part, due to the intergenerational impacts associated with EDC exposure that can then be tied to these structures. The erasure of EDC exposure through air pollution and industry is an erasure of the uneven harms borne by Indigenous and frontline communities, but also an erasure of the structural analysis necessary to approach EDCs and create relations of responsibility for dismantling settler colonialism. Relegating our analyses to consumer products, body-centric scopes, and single EDCs serves to frame EDCs as an individualized issue that is limited to molecular-level harm. We hope to activate and build upon efforts which trace the extension and responsibility for chemical violence within settler colonialism—including the expansive and cumulative EDC exposures that stretch from industrial emissions into myriad dimensions of life and Land.

As work on *The Land and the Refinery* project continues, we aim to go beyond a focus that attaches peer-review health research to EDCs, and to include and reframe the thick body of work by scientists and community knowledge holders about the effects to animals, plants, and waters. In a human-centric frame, animal studies of the effects of EDCs are evidence toward possible harms to human health, rather than evidence of the more-than-human harms that EDCs create in their intergenerational disruptions to both Land and bodies. We expect the work of this project to be ongoing, and hopefully to be passed intergenerationally, just as we have tried to take up the teachings and work of those Land protectors who have gone before us.

Conclusion: Structures and Land/Body Relations

Through this conceptualization of EDCs as a structural relation of chemical violence that manifests settler colonialism, racial capitalism, and the gendered economy of pollution, new possibilities emerge. Individualization encourages environmental approaches that focus on body-burdens of harm, as well as the often feminized burdens of responsibility for mitigating those harms. In this dominant approach, the prime opportunity for action is through individual and consumer-based practices, which do little to mitigate the extent and impacts of EDCs, are largely unavailable to working-class and poor communities, facilitate racist and classist narratives of individual choice and blame, and allude to the private sector as the solution to the adverse consequences associated with EDCs—such as through consuming organic produce, installing water filtration devices, or using "toxic-free" cosmetics. Rather than solutions, this type of approach perpetuates gendered environmental injustice through intensified feminized burdens of reproductive labor, which individualize responsibility and blame for chemical violence. These are compounded in Indigenous and racialized contexts in which freedom of choice and blame narratives are utilized to perpetuate deficiency narratives.

However, as we shift focus beyond individualized, body-centric, and damage-centered approaches towards Land/body relations and a structural distributed reproduction frame, new ways of responding to environmental violence come to the fore. A structural lens highlights collective, cumulative, and intergenerational harms, their roots in settler colonialism and racial capitalism, and their manifestations across varied but interconnected sites of chemical violence. This structural analysis facilitates transnational and intergenerational solidarities across communities impacted by chemical violence at its various stages in the commodity chain (see Wylie, Liboiron, & Shapiro, 2017)—from the Athabasca Chipewyan First Nation and Mikisew Cree First Nation downstream from Alberta's tar sands (extraction), to Aamjiwnaang First Nation, on whose land Chemical Valley sits (refining), to predominantly racialized and immigrant nail technicians occupationally exposed to phthalates and acetone, both produced from petrochemicals (consumption), and to fatal emissions and waste dumping, such as in the former Union Carbide plant in Old Bhopal, India, which used carbaryl (containing petroleum distillates) to manufacture and formulate the pesticide Sevin.

To highlight the structures that underlie chemical violence is to assign responsibility to the perpetrators of that violence and demand its end. At the

same time, activating a decolonial Land/body framework depends on re-building our relations with Land and community life-support. Decolonial futures are possible in the ethical relationality we make together (Arvin, Tuck, & Morrill, 2013; Donald, 2012; Konsmo & Recollet, 2019; Todd, 2016; Betasamosake Simpson, 2017). As we shift our gaze beyond individualist framings and solutions and towards structures of power, oppression, and exploitation, we move towards collective action, to hold perpetrators accountable, to dismantle colonialism, to build and rebuild relationships of solidarity and mutual aid, to respect Land/body sovereignties, and to enact the futures we desire.

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Notes

[1] We use capital *L* "Land" in this paper to indicate an understanding of land that is not commensurate with territory or earth, but rather includes nonhumans, ancestors, future generations, and "all our relations" stretching both backward and forward in time. This understanding of Land seeks to honor Anishinaabek and Haudenosaunee teachings, which are distinctive, but which both emphasize kinship with land and are both manifest as part of Indigenous law in the lower Great Lakes region. This generational emphasis on Land extends to many Indigenous understandings of Land/body, but at the same time is specific within different nations. This approach to Land is discussed further in the paper.

[2]In the last two decades, endocrine disruption has been legitimized as a form of chemical violence. In 2002 the World Health Organization (WHO), the International Labour Organisation (ILO), and the United Nations Environment Programme (UNEP) recognized EDCs as substances of concern with the release of *Global Assessment of the State-of-the-Science of Endocrine Disruption* (Damstra, Barlow, Bergman, Kavlock, & Van Der Kraak, 2002). This report summarized growing scientific concern on endocrine disruption as a mode of chemical violence with the potential to cause adverse health impacts in human and nonhuman bodies. *Global Assessment of the State-of-the-Science of Endocrine Disruption* built

upon the recommendations put forth by the Intergovernmental Forum on Chemical Safety in February 1997 and the 1997 Declaration of the Environmental Leaders of the Eight on Children's Environmental Health. State-level measures to address EDCs also emerged in the late 1990s. In 1996 the United States Environmental Protection Agency (EPA) began to screen potential EDCs (primarily in pesticides) under the Food Quality Protection Act and the Safe Drinking Water Act (United States Environmental Protection Agency, 2017). In the same year, Theo Colborn, Dianne Dumanoski, and John Peterson Myers (1996) published the groundbreaking *Our Stolen Future*, which brought attention to the intergenerational violences of EDCs. In 1997 the European Parliament began its own efforts to prompt research and action on EDCs (Commission of the European Communities, 1999), and in Canada, hormone-disrupting chemicals were included in the Canadian Environmental Protection Act, 1999. A decade later, UNEP and WHO released *State of the Science of Endocrine Disrupting Chemicals – 2012* (Bergman, Heindel, Jobling, Kidd, & Zoeller, 2013). The more recent report points to holes in EDC research and, by extension, regulatory measures. WHO and UNEP thus called for several interventions, including more comprehensive methods to identify EDCs, sources of EDC exposure and exposure routes; attention to cumulative EDC exposures, particularly in industrial zones; better reporting of EDCs in products and materials, and; data sharing to improve international EDC awareness and action (Bergman et al., 2013).

[3] In *Wastelanding: Legacies of Uranium Mining in Navajo Country*, Traci Brynne Voyles calls wastelanding an "underexplored component of environmental racism" (p. 9). Voyles extends Kuletz's (1998) work on wasteland discourse, and defines wastelands as "a racial and a spatial signifier that renders an environment and the bodies that inhabit it pollutable" (p. 10). Wastelands are not limited to arid, barren landscapes. Various lands and those that occupy them can be deemed "wastelands" to facilitate resource extraction and polluting practices (Voyles, 2015). This practice connects to capitalist logics, in which place is transformed to manifest relations of inequality.

[4] There are points of interaction in the albeit profoundly different histories and experiences of occupation in South Asia and the Americas—exploitation, displacement, violence (often gendered), and disruptions to social, cultural, economic, and political organization. However, there are also important dynamics to attend to, such as South Asian complicities in settler colonialism in the Americas, as well as ongoing threats to Indigenous communities within South Asia, such as in the Indian state's efforts to impose uranium mining on Adivasi

lands.

[5] Our understandings of distributions of exposure to early mortality as constitutive of settler colonial environmental violence is indebted to Ruth Gilmore's (2007) theorization of racism as "the state-sanctioned or extralegal production and exploitation of group-differentiated vulnerability to premature death" (p. 28).

[6] Epigenetic research tends to differentiate between intergenerational and transgenerational effects. Intergenerational effects denote the exposure of three generations when a pregnant being is exposed, thereby affecting the parent, the fetus, and the fetus's gametes. Transgenerational effects are caused by inherited changes to the epigenome that then affects gene expression and can thus extend beyond three generations as an inheritable alteration.

[7] Nancy Langston's (2010) case study on diethylstilbestrol (DES) is a notable example of the intergenerational violences of EDCs. DES is a synthetic estrogen and known endocrine disrupter. DES was prescribed to alleviate symptoms of menopause, as well as to prevent miscarriages. However, in 1971, Boston-based researchers found a cluster of women with rare vaginal cancers. It was discovered that their mothers had consumed DES during their pregnancies, the impacts of which only became apparent in their daughters following puberty (Langston, 2010).

[8] We also note that new materialist relational theorizations tend to obscure their debt and relation to Indigenous epistemologies and ontologies (Todd, 2016; Watts, 2013).

[9] For instance, Liboiron, Tironi, & Calvillo (2018) point to the cost-benefit analysis that underlies much toxics regulation. This is apparent in Ontario, where Ontario Regulation 419/05: Air Pollution – Local Air Quality allows facilities to bypass the provincial air quality standards if they are unable to meet the requirements for cost-related or technical reasons. As an alternative, facilities can apply for sector-specific or site-specific standards ("technical standards"), which allow facilities to exceed provincial air pollution standards. In Chemical Valley, Imperial Oil and several other facilities use technical standards for benzene emissions.

[10] Flaws in the federal-level regulatory approach were highlighted in recent efforts to reform the Canadian Environmental Protection Act, 1999. In June 2017, the Standing Committee on Environment and Sustainable Development (2017)

released eighty-seven recommendations related to toxics governance in Canada. These recommendations were formed alongside various stakeholders, including experts in environmental law, health, and justice, including Indigenous Nations and frontline communities. EDCs are noted explicitly in two recommendations, but relate to a number of the other recommendations put forth. Specifically, recommendation 39 states, "The Committee recommends that the government revise the definition of 'toxic' to ensure that it addresses endocrine disruptors." Moreover, recommendation 44 states, "The Committee recommends that Environment and Climate Change Canada and Health Canada implement measures, thresholds, techniques and reporting requirements specifically addressing endocrine disruptors." The latter recommendation was promoted in part due to the fact that there is no safe threshold of exposure for EDCs. This is further reflected in recommendation 40, which states "that sections 64 and 68 of CEPA be amended to expressly address substances that are dangerous at low level quantity thresholds." The Standing Committee further proposed recommendations related to the disproportionate impacts of EDCs and other chemical exposures, consistent with an environmental justice and environmental violence lens (Standing Committee on Environment and Sustainable Development, 2017). In June 2018, the Government of Canada responded to Standing Committee's recommendations with an expressed commitment to improving the consideration of EDCs in risk assessments, better addressing low-dose and cumulative impacts, and improving protections for "vulnerable populations" (Environment and Climate Change Canada, 2018). How these commitments will manifest in practice remains unclear, however.

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