



Preliminary Regulatory Analyses:

Including the:

- Preliminary Cost-Benefit Analysis
- Least-Burdensome Alternative Analysis
- Administrative Procedure Act Determinations
- Regulatory Fairness Act Compliance

Chapter 173-408 WAC

Landfill Methane Emissions

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For the

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¹ www.ecology.wa.gov/contact

Department of Ecology's Regional Offices

Map of Counties Served



Southwest Region 360-407-6300	Northwest Region 206-594-0000	Central Region 509-575-2490	Eastern Region 509-329-3400
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Region	Counties served	Mailing Address	Phone
Southwest	Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Mason, Lewis, Pacific, Pierce, Skamania, Thurston, Wahkiakum	P.O. Box 47775 Olympia, WA 98504	360-407-6300
Northwest	Island, King, Kitsap, San Juan, Skagit, Snohomish, Whatcom	P.O. Box 330316 Shoreline, WA 98133	206-594-0000
Central	Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, Yakima	1250 W Alder St Union Gap, WA 98903	509-575-2490
Eastern	Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman	4601 N Monroe Spokane, WA 99205	509-329-3400
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Chapter 173-408 WAC, Landfill Methane
Emissions

Air Quality Program
Washington State Department of Ecology
Olympia, WA

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DEPARTMENT OF
ECOLOGY
State of Washington

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Abbreviations

CH ₄	Methane
GCCS	Gas Collection and Control System
GHG	Greenhouse Gas
HIC	Heat Input Capacity
IPCC	Intergovernmental Panel on Climate Change
LFG	Landfill Gas
MMT	Million metric tons
MSW	Municipal Solid Waste
NMOC	Non-methane Organic Compound
NPV	Net Present Value
NSPS	New Source Performance Standards
ppmv	parts per million by volume
VOC	Volatile organic compound
WIP	Waste-in-Place (total amount of solid waste placed in a landfill, estimated in tons)

Executive Summary

This report presents the determinations made by the Washington State Department of Ecology as required under Chapters 34.05 RCW and 19.85 RCW, for the proposed new rule, Landfill Methane Emissions (Chapter 173-408 WAC; the “rule”). This includes the:

- Preliminary Cost-Benefit Analysis (CBA)
- Least-Burdensome Alternative Analysis (LBA)
- Administrative Procedure Act Determinations
- Regulatory Fairness Act Compliance

The Washington Administrative Procedure Act (APA; RCW 34.05.328(1)(d)) requires Ecology to evaluate significant legislative rules to “determine that the probable benefits of the rule are greater than its probable costs, taking into account both the qualitative and quantitative benefits and costs and the specific directives of the law being implemented.” Chapters 1 – 5 of this document describe that determination.

The APA also requires Ecology to “determine, after considering alternative versions of the rule...that the rule being adopted is the least burdensome alternative for those required to comply with it that will achieve the general goals and specific objectives” of the governing and authorizing statutes. Chapter 6 of this document describes that determination.

The APA also requires Ecology to make several other determinations (RCW 34.05.328(1)(a) – (c) and (f) – (h)) about the rule, including authorization, need, context, and coordination. Appendix A of this document provides the documentation for these determinations.

The Washington Regulatory Fairness Act (RFA; Chapter 19.85 RCW) requires Ecology to evaluate the relative impact of proposed rules that impose costs on businesses in an industry. It compares the relative compliance costs for small businesses to those of the largest businesses affected. Chapter 7 of this document documents that analysis, when applicable.

All determinations are based on the best available information at the time of publication. We encourage feedback (including specific data) that may improve the accuracy of this analysis.

Chapter 173-408 WAC would establish various requirements for (MSW) landfills, including the following:

Technology and Performance Requirements:

- Gas collection and control system (GCCS) installation
- GCCS design plan
- Landfill gas control system equipment requirements
- GCCS performance requirements
- Adopting methane destruction efficiency requirements for flares and energy recovery control devices
- Adopting requirements for open flare systems

- Adopting requirements for landfill gas treatment and processing
- Wellhead gauge pressure requirements
- Requirements for devices measuring gauge pressure
- Requirements for instruments used to measure methane
- Control device destruction efficiency calculation requirements
- Gas generation flow rate calculation requirements
- Source testing requirements for any gas control device or devices

Monitoring Requirements:

- Instantaneous and integrated surface emissions monitoring
- Surface monitoring design plan
- Remonitoring and corrective action(s) for methane limit exceedances
- Gas collection and control system (GCCS) component monitoring
- Adopting methane leak rate limits for treatment systems that process routed gas
- Wellhead gauge pressure monitoring
- Requirements for shutdown and removal of the GCCS

Reporting and Recordkeeping Requirements:

- Waste in place reporting
- Landfill gas heat input capacity calculation and reporting
- Surface emissions monitoring reporting
- Gas collection and control system (GCCS) operations reporting
- Records maintenance for monitoring, source testing, landfill operations, operation of the GCCS, methane level exceedances, and actions involving the disturbance or removal of areas of the landfill surface
- Reporting for capping of landfill gas collection wells, removal, or cessation of GCCS equipment
- Landfill closure reporting to Ecology or the local clean air agency

Other Requirements:

- Incorporating new statutory civil penalties for violation of the law and implementing rules
- Adopting maximum methane concentration limits for both owners and operators of active and closed MSW landfills
- Adopting exemptions for methane concentration limit exceedances due to activities defined in RCW 70A.540.050(3)
- Establishing a method for landfills to claim exemption from the rule
- Establishing alternative compliance measures

Costs

The proposed rule adds costs for equipment upgrades, increased monitoring and GCCS design plans. Ecology estimates that the total one-time costs will be between roughly \$10.3 million to

\$10.4 million. Additionally, the proposed rule causes Washington landfills to incur a total of nearly an estimated \$846,000 to \$871,000 in ongoing, annual costs. These costs bring a new present value (NPV) of \$15.6 million to \$16 million over the 20-year planning frame of the proposed rule². Combining these yields a total estimated cost range of \$25.9 million to \$26.4 million.

There are potential additional costs due to the proposed rule, however, these are site specific and estimating and aggregating them is nonviable.

Benefits

The proposed rule primarily creates benefits in the form of decreased emissions of methane. Estimating the benefits of the proposed rule requires estimating the impact it will have on improving the collection of methane and providing conversion of collected methane to beneficial uses or less potent greenhouse gases. To do this estimation, we used the impacts of the California Landfill Methane control regulation³ as a proxy. Under the California regulation, the collection and beneficial use of landfill methane as energy increased by 5%. The collection and conversion to less potent greenhouse gases by flaring of landfill methane increased by 33%.

Applying these percentage gains to the average of the last 5 years of methane captured in Washington yields an estimated increase of roughly .02 MMT of methane controlled annually due to the proposed rule. The social cost of methane is estimated at \$1,500 per ton. Therefore, the estimated benefits attributable to the proposed rule are \$32.3 million annually. These annual benefits bring a NPV of nearly \$595 million over the 20-year planning frame of the proposed rule⁴. If only 10% of the benefits relative to the California regulation materialize, the estimated benefits will be nearly \$60 million.

Conclusion

We conclude, based on a reasonable understanding of the quantified and qualitative costs and benefits likely to arise from the proposed rule, as compared to the baseline, that the benefits of the proposed rule are greater than the costs.

Least burdensome analysis

We considered the following alternative rule content and did not include it in the proposed rule for the reasons discussed in each subsection below.

- Bimonthly surface emissions monitoring.
- Bimonthly GCCS components monitoring.
- Limit landfill working face and wet waste concentrations.
- Higher destruction efficiency.

² Discounted at a rate of 0.89%.

³ This regulation is comparable to the proposed rule and went into effect after 2001.

⁴ Discounted at a rate of 0.89%.

- Exempting landfills that only accepted waste for part of 1992.
- Full exemption for landfills regulated under CERCLA.
- Not including wind speed requirements for monitoring.
- Increasing the monitoring traverse spacing.
- Approving ALT-150 for compliance.
- Making all required records available to the public and air agencies.
- Requiring a surface monitoring report after 4th consecutive quarterly monitoring period.
- Requiring landfills to record surface emissions exceedances over 100 ppmv.
- Not easing the monitoring traverse.
- Requiring monthly monitoring for specific areas.
- Creating gas shipping requirements.

After considering alternatives to the rule's contents, within the context of the goals and objectives of the authorizing statute, we determined that the adopted rule represents the least-burdensome alternative of possible rule contents meeting the goals and objectives.

Regulatory Fairness Act

Five private businesses would be required to comply with the proposed rule. None of these businesses are a small business at the highest ownership and operator level as defined by the Regulatory Fairness Act. The employment of the businesses ranges from 120 to 140,500 employees.

We conclude that since the rule does not impose compliance costs on small businesses, we are exempt from the regulatory fairness act under RCW 19.85.0254(4), which states that this chapter does not apply to the adoption of a rule if an agency is able to demonstrate that the proposed rule does not affect small businesses.

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Chapter 1: Background and Introduction

1.1 Introduction

This report presents the determinations made by the Washington State Department of Ecology as required under Chapters 34.05 RCW and 19.85 RCW, for the proposed new rule, Landfill Methane Emissions (Chapter 173-408 WAC; the “rule”). This includes the:

- Preliminary Cost-Benefit Analysis (CBA)
- Least-Burdensome Alternative Analysis (LBA)
- Administrative Procedure Act Determinations
- Regulatory Fairness Act Compliance

The Washington Administrative Procedure Act (APA; RCW 34.05.328(1)(d)) requires Ecology to evaluate significant legislative rules to “determine that the probable benefits of the rule are greater than its probable costs, taking into account both the qualitative and quantitative benefits and costs and the specific directives of the law being implemented.” Chapters 1 – 5 of this document describe that determination.

The APA also requires Ecology to “determine, after considering alternative versions of the rule...that the rule being adopted is the least burdensome alternative for those required to comply with it that will achieve the general goals and specific objectives” of the governing and authorizing statutes. Chapter 6 of this document describes that determination.

The APA also requires Ecology to make several other determinations (RCW 34.05.328(1)(a) – (c) and (f) – (h)) about the rule, including authorization, need, context, and coordination. Appendix A of this document provides the documentation for these determinations.

The Washington Regulatory Fairness Act (RFA; Chapter 19.85 RCW) requires Ecology to evaluate the relative impact of proposed rules that impose costs on businesses in an industry. It compares the relative compliance costs for small businesses to those of the largest businesses affected. Chapter 7 of this document documents that analysis, when applicable.

All determinations are based on the best available information at the time of publication. We encourage feedback (including specific data) that may improve the accuracy of this analysis.

1.1.1 Background

The proposed rulemaking would create a new chapter in the Washington Administrative Code (WAC), Chapter 173-408 WAC – Landfill Methane Emissions. This new chapter would implement Reducing Methane Emissions from Landfills (Engrossed Second Substitute House Bill 1663, Chapter 179, Laws of 2022, codified as Chapter 70A.540 RCW⁵). It regulates both closed

⁵ <http://app.leg.wa.gov/RCW/default.aspx?cite=70A.540>

and active municipal solid waste (MSW) landfills that have received solid waste after January 1, 1992.⁶

Organic material such as food scraps and yard waste are often disposed of in MSW landfills. As this organic material decays, it initially consumes oxygen. With time, the buried environment begins to lack oxygen (becomes anerobic). In such an environment the further decaying organic material produces and releases methane gas (CH₄). Gas emissions from MSW landfills are approximately 50 percent methane and 50 percent carbon dioxide (CO₂), with trace amounts of other organic compounds. Some of the trace organic compounds are odorous, hazardous, or both, and have historically been the focus of landfill gas (LFG) regulation under air quality statutes.

This rulemaking would implement more protective standards for methane emissions than are currently required under the federal Clean Air Act, resulting in the capture of more methane from MSW landfills across the state.

As a result of this rulemaking, Washington State will join California, Oregon and Maryland in adopting more protective standards than federal law for methane emissions from MSW landfills.

1.2 Summary of the proposed rule

WAC 173-408 would establish various requirements for (MSW) landfills, including the following:

Technology and Performance Requirements:

- Gas collection and control system (GCCS) installation
- GCCS design plan
- Landfill gas control system equipment requirements
- GCCS performance requirements
- Adopting methane destruction efficiency requirements for flares and energy recovery control devices
- Adopting requirements for open flare systems
- Adopting requirements for landfill gas treatment and processing
- Wellhead gauge pressure requirements
- Requirements for devices measuring gauge pressure
- Requirements for instruments used to measure methane
- Control device destruction efficiency calculation requirements
- Gas generation flow rate calculation requirements
- Source testing requirements for any gas control device or devices

Monitoring Requirements:

⁶ WAC 173-408-010

- Instantaneous and integrated surface emissions monitoring
- Surface monitoring design plan
- Remonitoring and corrective action(s) for methane limit exceedances
- Gas collection and control system (GCCS) component monitoring
- Adopting methane leak rate limits for treatment systems that process routed gas
- Wellhead gauge pressure monitoring
- Requirements for shutdown and removal of the GCCS

Reporting and Recordkeeping Requirements:

- Waste in place reporting
- Landfill gas heat input capacity calculation and reporting
- Surface emissions monitoring reporting
- Gas collection and control system (GCCS) operations reporting
- Records maintenance for monitoring, source testing, landfill operations, operation of the GCCS, methane level exceedances, and actions involving the disturbance or removal of areas of the landfill surface
- Reporting for capping of landfill gas collection wells, removal, or cessation of GCCS equipment
- Landfill closure reporting to Ecology or the local clean air agency

Other Requirements:

- Incorporating new statutory civil penalties for violation of the law and implementing rules
- Adopting maximum methane concentration limits for both owners and operators of active and closed MSW landfills
- Adopting exemptions for methane concentration limit exceedances due to activities defined in RCW 70A.540.050(3)
- Establishing a method for landfills to claim exemption from the rule
- Establishing alternative compliance measures

1.3 Reasons for the proposed rule

Methane is a potent greenhouse gas (GHG). Pound for pound over 20 years it is 84 times more potent at warming the atmosphere than carbon dioxide. Over the course of 100 years, it is 28 times as powerful⁷. It does break down over time. According to the Intergovernmental Panel on Climate Change (IPCC), reducing methane emissions is one of best strategies for mitigating the impacts of climate change in the near-term.⁸

⁷ [Chapter.2_FINAL.indd \(ipcc.ch\)](#)

⁸ [Control methane to slow global warming — fast \(nature.com\)](#)

“Municipal solid waste landfills are the third-largest source of human-related methane emissions in the United States, accounting for approximately 14.3 percent of these emissions in 2021.”⁹

Landfills are a concentrated source of methane emissions in Washington. Ecology’s most recent GHG inventory reported approximately 1.6 million metric tons of carbon dioxide equivalent emissions were from solid waste. This was approximately 1.6% of the state’s total GHG emissions in 2019¹⁰. Emissions from landfills totaled nearly 1.5 million tons¹¹.

“Reducing methane emissions is an essential part of an overall strategy to address climate change. Climate change impacts threaten our health—by exposing us to extreme heat waves, degraded air quality, and diseases spread through food, water, and insects—and they threaten our economy by increasing insurance premiums and food prices and damaging our infrastructure and ecosystems. The most vulnerable among us—including children, older adults, people with pre-existing medical conditions and people living in poverty—are most at risk from the impacts of climate change.”¹²

In March 2022, the governor signed the Landfills – Methane Emissions law (Chapter 70A.540 RCW) which directs Ecology to adopt rules to implement the law.

Washington law RCW 70A.540.020 requires that Ecology adopt rules to implement the requirements in the statute.

This legislation and rulemaking align with Washington State’s 2030, 2040, and 2050 GHG reduction goals. Based on current science and emissions trends, Washington must achieve these limits to support the global effort to avoid the most significant impacts of climate change.

Chapter 70A.540 RCW states that no location on a MSW landfill surface may exceed the following methane concentration limits:

- Five hundred parts per million by volume as determined by instantaneous surface emissions monitoring; or
- An average methane concentration limit of 25 parts per million by volume as determined by integrated surface emissions monitoring.

The law requires these limits to go into effect beginning January 1st of the year following Ecology’s adoption of rules to implement Chapter 70A.540 RCW, or upon commencing operation of a newly installed GCCS or modification of an existing GCCS, whichever is later. In addition, Ecology may postpone the effective date of these limits to accommodate significant

⁹ [Basic Information about Landfill Gas | US EPA](#)

¹⁰ [Washington State Greenhouse Gas Emissions Inventory: 1990–2019](#)

¹¹ Waterman-Hoey, S. (2022). Washington State Greenhouse Gas Emissions Inventory: 1990–2019 (Publication 22-02-054)

¹² <https://www.epa.gov/sites/default/files/2016-09/documents/landfills-final-nsp-eg-factsheet.pdf>

technological improvements, such as the installation of an energy recovery device or devices, for up to 24 months after Ecology's adoption of these rules.

If Ecology does not adopt rules to implement the law, then the above statutory methane concentration limits cannot go into effect.

1.4 Document organization

The remainder of this document is organized in the following chapters:

- **Baseline and the proposed rule (Chapter 2):** Description and comparison of the baseline (what would occur in the absence of the proposed rule) and the proposed rule requirements.
- **Likely costs of the proposed rule (Chapter 3):** Analysis of the types and sizes of costs we expect impacted entities to incur as a result of the proposed rule.
- **Likely benefits of the proposed rule (Chapter 4):** Analysis of the types and sizes of benefits we expect to result from the proposed rule.
- **Cost-benefit comparison and conclusions (Chapter 5):** Discussion of the complete implications of the CBA.
- **Least-Burdensome Alternative Analysis (Chapter 6):** Analysis of considered alternatives to the contents of the proposed rule.
- **Regulatory Fairness Act Compliance (Chapter 7):** When applicable. Comparison of compliance costs for small and large businesses; mitigation; impact on jobs.
- **APA Determinations (Appendix A):** RCW 34.05.328 determinations not discussed in chapters 5 and 6.

Chapter 2: Baseline and the Proposed Rule

2.1 Introduction

We analyzed the impacts of the proposed rule, within the context of all existing requirements (federal and state laws and rules). This context for comparison is called the baseline and reflects the most likely regulatory circumstances that entities would face if the proposed rule was not adopted.

2.2 Baseline

The baseline for our analyses generally consists of existing laws and rules. This is what allows us to make a consistent comparison between the state of the world with and without the proposed rule.

For this rulemaking, the baseline includes federal regulations pertaining to methane emissions from municipal solid waste (MSW) landfills, and the state law that authorizes this rulemaking. That law, RCW 70A.540¹³, establishes several requirements that are incorporated into this rule and applies them to MSW landfills that accepted waste after Jan. 1, 1992. Ecology's rule provides further details on how some of the statutory requirements are to be met or implemented.

The baseline also includes existing requirements established under the federal Clean Air Act. On July 14, 2016, the U.S. Environmental Protection Agency (EPA) revised the New Source Performance Standards (NSPS) for new, modified, and reconstructed MSW landfills, updating standards that were first adopted in 1996 in order to reduce emissions of methane-rich landfill gas. In a separate action, EPA also revised the Emissions Guidelines for existing MSW landfills, which also were first issued in 1996.¹⁴ Both actions are part of the President's Climate Action Plan: Strategy to Reduce Methane Emissions¹⁵.

The federal regulations pertaining to landfill gas emissions vary based on the date of construction or significant modification to the landfill. Older landfills are subject to slightly less restrictive regulation. The federal regulations pertaining to MSW landfills are set forth in 40 CFR Part 60, and the applicable Subpart is determined by the date of construction or modification as follows:

¹³ <http://app.leg.wa.gov/RCW/default.aspx?cite=70A.540>

¹⁴ In 2021, EPA adopted a Federal Plan to implement the revised Emissions Guidelines in states that did not adopt state plans to implement 40 CFR Part 60, Subpart Cf. This Federal Plan is set forth in 40 CFR Part 62, Subpart OOO. Ecology subsequently adopted the Federal Plan into state law. See WAC 173-400-070(7). Ecology is also in the process of seeking federal delegation from EPA to implement and enforce the Federal Plan.

¹⁵ <https://www.epa.gov/sites/default/files/2016-09/documents/landfills-final-nsp-eg-factsheet.pdf>

Subpart Cc:

Emissions Guidelines for existing MSW landfills for which construction, reconstruction or modification was commenced before May 30, 1991. 40 CFR 60.32c(a).

Subpart Cf:

Emissions Guidelines for existing MSW landfills for which construction, reconstruction or modification was commenced on or before July 17, 2014. 40 CFR 60.31f(a).

Subpart WWW:

New Source Performance Standards for MSW landfills that commenced construction, reconstruction, or modification¹⁶ on or after May 30, 1991, but before July 18, 2014. 40 CFR 60.750(a).

Subpart OOO:

Federal Plan requirements for MSW landfills that commenced construction on or before July 17, 2014 and have not been modified or reconstructed since July 17, 2014. 40 CFR 62.16714.

Subpart XXX:

New Source Performance Standards for MSW landfills that commenced construction, reconstruction, or modification¹⁷ after July 17, 2014. 40 CFR 60.760(a).

The federal regulations have multiple criteria to determine whether a GCCS system is required for a particular MSW landfill. The first component considers whether a landfill has a “design capacity” of 2.5 million metric tons (by mass) or 2.5 million cubic meters (by volume) of waste.¹⁸ Landfills with a design capacity under this threshold are exempt from federal requirements to install a GCCS system.

The second criterion is the volume of emissions of non-methane organic compounds (NMOC) produced by the landfill. These compounds are used as a surrogate for all landfill gases and typically comprise < 1% of landfill gas (LFG).¹⁹ They can be odorous, hazardous, or both, and were historically the focus of concern regarding landfill gas. For all new or modified landfills subject to Subpart XXX and for active existing landfills subject to Subpart Cf, the threshold is 34 metric tons/year of NMOC.²⁰ For closed existing landfills subject to Subpart Cf, the threshold is 50 metric tons/year.²¹

¹⁶ “Modification” is defined as “an increase in the permitted volume design capacity of the landfill by either horizontal or vertical expansion based on its permitted design capacity as of May 30, 1991. Modification does not occur until the owner or operator commences construction on the horizontal or vertical expansion.” 40 CFR 60.751.

¹⁷ Physical or operational changes made to an MSW landfill solely to comply with Subparts Cc, Cf, or WWW of 40 CFR Part 60 are not considered “construction, reconstruction, or modification.” 40 CFR 60.760(a).

¹⁸ 40 CFR §§ 60.33c(e), 60.33f(e), 60.752(b), 60.762(b)

¹⁹ [Frequent Questions about Landfill Gas | US EPA](#)

²⁰ 40 CFR §§ 60.33f(a)(3), 60.762(b)(2)

²¹ 40 CFR §§ 60.33f(a)(4)

In general, landfills with a design capacity and NMOC emissions above the applicable thresholds are required to install a GCCS System, which must meet specified operational standards.²² However, there is also a provision in Subpart Cf for active existing landfills (built or modified on or before July 17, 2014) that emit between 34 and 50 metric tons of NMOC/year, and can demonstrate surface concentrations of methane do not exceed 500 ppmv.²³ In this instance, a GCCS is not required.²⁴

The federal regulations for methane emissions from MSW landfills also include monitoring,²⁵ recordkeeping,²⁶ and reporting²⁷ requirements.

2.3 Proposed rule

The proposed rule would impose the following requirements on owners and operators of certain MSW landfills, as well as third party owners and operators²⁸ who operate all or a portion of a GCCS or energy recovery device, and/or purchase or obtain untreated landfill gas from a MSW landfill subject to the requirements of the proposed rule:

Technology and Performance Requirements:

- Gas collection and control system (GCCS) installation
- GCCS design plan
- Landfill gas control system equipment requirements
- GCCS performance requirements
- Adopting methane destruction efficiency requirements for flares and energy recovery control devices
- Adopting requirements for open flare systems
- Adopting requirements for landfill gas treatment and processing
- Wellhead gauge pressure requirements
- Requirements for devices measuring gauge pressure
- Requirements for instruments used to measure methane
- Control device destruction efficiency calculation requirements
- Gas generation flow rate calculation requirements
- Source testing requirements for any gas control device or devices

Monitoring Requirements:

- Instantaneous and integrated surface emissions monitoring

²² 40 CFR §§ 60.34f, 60.763

²³ 40 CFR 60.35f(a)(6)

²⁴ 40 CFR § 60.33f(b)(1)(iii), (e)(2)

²⁵ 40 CFR §§ 60.37f, 60.766

²⁶ 40 CFR §§ 60.39f, 60.768

²⁷ 40 CFR §§ 60.38f, 60.767

²⁸ This is a requirement of the law

- Surface monitoring design plan
- Remonitoring and corrective action(s) for methane limit exceedances
- Gas collection and control system (GCCS) component monitoring
- Adopting methane leak rate limits for treatment systems that process routed gas
- Wellhead gauge pressure monitoring
- Requirements for shutdown and removal of the GCCS

Reporting and Recordkeeping Requirements:

- Waste in place reporting
- Landfill gas heat input capacity calculation and reporting
- Surface emissions monitoring reporting
- Gas collection and control system (GCCS) operations reporting
- Records maintenance for monitoring, source testing, landfill operations, operation of the GCCS, methane level exceedances, and actions involving the disturbance or removal of areas of the landfill surface
- Reporting for capping of landfill gas collection wells, removal, or cessation of GCCS equipment
- Landfill closure reporting to Ecology or the local clean air agency

Other Requirements:

- Incorporating new statutory civil penalties for violation of the law and implementing rules
- Adopting maximum methane concentration limits for both owners and operators of active and closed MSW landfills
- Adopting exemptions for methane concentration limit exceedances due to activities defined in RCW 70A.540.050(3)
- Establishing a method for landfills to claim exemption from the rule
- Establishing alternative compliance measures

2.3.1 Technology and Performance Requirements

2.3.1.1 Gas Collection and Control System Installation

Baseline

State law

RCW 70A.540 requires gas collection and control for smaller landfills as compared to federal regulations, unless certain conditions are met.

The law applies to all MSW landfills that accepted solid waste after Jan. 1, 1992. It requires installation of a GCCS at the following landfills:

- Active MSW landfills with over 450,000 tons of waste in place (WIP) and a Heat Input Capacity (HIC) (recoverable as methane) of over 3 million BTU/hour; or

- Closed MSW landfills with more than 750,000 tons of WIP and a HIC (recoverable as methane) of over 3 million BTU/hour.

An exception is provided if the owner or operator can demonstrate that surface methane concentrations do not meet or exceed 200 ppmv over four consecutive monitoring periods.

Federal requirements

Federal regulations require a MSW landfill to install a GCCS if they meet three main criteria:

- The landfill has accepted waste any time since Nov. 8, 1987
- The landfill has a design capacity greater than or equal to 2.5 million megagrams by mass and 2.5 million cubic meters by volume
- The landfill has an non-methane organic compound (NMOC) emissions rate greater than or equal to 34 megagrams per year, or surface emissions monitoring shows a surface emissions concentration of 500 parts per million methane or greater.

There is a federal exemption for these landfills constructed or modified after 2014 that emit between 34 and 50 megagrams of NMOC/yr and can demonstrate by surface monitoring that surface methane concentrations don't meet or exceed 500 ppmv.²⁹

Proposed

Threshold criteria for requiring a GCCS at MSW landfills based on WIP and HIC are set in RCW 70A.540. "Waste in place" means the total amount of solid waste placed in the MSW landfill estimated in tons. The solid waste density is assumed to be 1,300 pounds per cubic yard, and the decomposable fraction is assumed to be 70 percent by weight, unless the department or local authority approves alternative values.

RCW 70A.540 requires MSW landfills to calculate their heat input capacity (HIC). The HIC is an estimate of how much energy emitted in the form of recoverable methane the MSW landfill produces. The HIC calculation method is specified in the rule, WAC 173-408 Appendix I, part 4.

Expected impact

The waste in place metric (WIP) for each landfill is a number that should be readily available. It's the same number reported to Ecology's Solid Waste Management Program. Therefore, there is little impact.

The heat input capacity (HIC) calculation must by state law follow the rule's methodology. That methodology is similar to EPA methodology and other industry standards. The estimated impact is minimal due to the similarity of methodologies used federally and for GHG estimates.

²⁹ 40 CFR 60.767(c)(4)(iii)

The benefit for the HIC calculation is getting an estimate of methane generation at MSW landfill sites, which will determine whether they need to collect and control methane onsite. Another benefit is consistency of methodology for all landfills making the calculation.

2.3.1.2 GCCS Design Plan

Baseline

State law

RCW 70A.540.040(2) specifies the general performance requirements of the GCCS:

“The gas collection and control system must handle the expected gas generation flow rate from the entire area of the municipal solid waste landfill and must collect gas at an extraction rate to comply with the surface methane emission limits set forth in RCW [70A.540.050](#) and the department's implementing rules.”

The methane concentration limits specified in RCW 70A.540.050 are as follows:

“No location on a municipal solid waste landfill surface may exceed the following methane concentration limits; (a) Five hundred parts per million by volume, ... or

(b) An average methane concentration limit of 25 parts per million by volume as determined by integrated surface emissions monitoring.”

Federal requirements

The current EPA regulations for newer landfills read similarly:

“An active collection system must: (1) Be designed to handle the maximum expected gas flow rate from the entire area of the landfill that warrants control over the intended use period of the gas control system equipment; ...³⁰

(3) Collect gas at a sufficient extraction rate;

(4) Be designed to minimize off-site migration of subsurface gas. Passive collection system must comply with the first 3.”

Furthermore, facilities must “Operate the collection system so that the methane concentration is less than 500 parts per million above background at the surface of the landfill.”³¹

Proposed

MSW landfills without GCCS systems currently in place, but that will now be required by statute to install them must submit a detailed design plan. Key aspects of the plan are as follows:

- The design plan must be prepared by and certified by a professional engineer.
- The design plan must demonstrate how the gas collection and control system will handle the expected gas generation flow rate from the entire area of the MSW landfill

³⁰ 40 CFR 60.762(b)(2)(ii)(C)(1)

³¹ [https://www.ecfr.gov/current/title-40/part-60/section-60.763#p-60.763\(d\)](https://www.ecfr.gov/current/title-40/part-60/section-60.763#p-60.763(d))

and collect gas at an extraction rate to comply with the surface methane emission limits...”

- “The following issues must be addressed in the design plan: depths of solid waste; solid waste gas generation rates and flow characteristics; cover properties; gas system expandability...”
- “The gas collection and control system must be operated, maintained, and expanded in accordance with the procedures and schedules in the approved design plan.”

Further, MSW landfills with a GCCS in place may have to amend their current design plans to meet the requirements of the proposed rule:

- “If an owner or operator is modifying an existing gas collection and control system to meet the requirements of this chapter, the existing design plan must be amended to include any necessary updates or addenda and must be certified by a professional engineer.”
- “An amended design plan must be submitted to the department or local authority within 90 days of any event that warrants a change to the design plan.”

Expected impact

The statute subjects an estimated 15 MSW landfills in the state to new GCCS Design Plan requirements. Some of those landfills already have some form of GCCS in place. Those without a GCCS in place will be required by the proposed rule to submit a detailed Design Plan, prepared, and certified by a professional engineer. This will have associated costs.

The benefit of a design plan is that it creates parameters for the proper and efficient operation of a GCCS, which will lead to more capture and control of methane.

The benefit of a professional engineer is that it provides accountability and consistency in regard to the preparation and certification of the design plan.

The benefit of an amended design plan is that it provides consistency so that all MSW landfills will have the same requirements for what should be included in their design plans.

2.3.2.3 Gas control system equipment requirements

Baseline

The authorizing statute defers to this rulemaking regarding specific operating and monitoring procedures for gas control and collection systems.

Federal requirements

The EPA regulations pertaining to newer landfills requires similar equipment to the proposed rule but applies only to some landfills with over 2.5 metric tons of waste. It reads as follows:

“(b) Each owner or operator seeking to comply with [§ 60.752\(b\)\(2\)\(iii\)](#) using an enclosed combustor shall calibrate, maintain, and operate according to the manufacturer's specifications, the following equipment:

(1) A temperature monitoring device equipped with a continuous recorder and having a minimum accuracy of ± 1 percent of the temperature being measured expressed in degrees Celsius or ± 0.5 degrees Celsius, whichever is greater. A temperature monitoring device is not required for boilers or process heaters with design heat input capacity equal to or greater than 44 megawatts.

(2) A device that records flow to or bypass of the control device. The owner or operator shall either:

(i) Install, calibrate, and maintain a gas flow rate measuring device that shall record the flow to the control device at least every 15 minutes; or

(ii) Secure the bypass line valve in the closed position with a car-seal or a lock-and-key type configuration. A visual inspection of the seal or closure mechanism shall be performed at least once every month to ensure that the valve is maintained in the closed position and that the gas flow is not diverted through the bypass line.”³²

Proposed

Proposed WAC 173-408-080(4) would establish the following requirements for enclosed flares. They must be equipped with:

- automatic dampers,
- an automatic shutdown device,
- a flame arrester, and
- continuous recording temperature sensors.

173-408-110(2)(a), the following monitoring equipment requirements are established:

- (i) A temperature monitoring device equipped with a continuous recorder which has an accuracy of plus or minus (\pm) 1 percent of the temperature being measured expressed in degrees Celsius or Fahrenheit.
- (ii) At least one gas flow rate measuring device which must record the flow to the control device(s) at least every 15 minutes.

Expected impact

More landfills will fall under these requirements due to the statute applying to a greater number of landfills. The specific requirements of the rule may require some of these landfills to purchase additional equipment or replace existing equipment to be able to meet requirements.

³² <https://www.ecfr.gov/current/title-40/section-60.756>

The benefit of the monitoring equipment is it will allow for more continuous, efficient operation of the methane destruction device. Another benefit to this equipment is that it will lead to safer operation of these gas control systems.

2.3.1.4 GCCS performance requirements

Baseline

State law

RCW 70a.540.040(3) states:

“The gas collection and control system must be designed and operated so that there is no landfill gas leak that exceeds 500 parts per million by volume, measured as methane, at any component under positive pressure.”

Leak monitoring of GCCS systems are not specifically required by EPA rule or operational standards for collection and control systems.³³

Federal Requirements

The EPA states that “landfill gas extraction components must be constructed of polyvinyl chloride (PVC), high density polyethylene (HDPE) pipe, fiberglass, stainless steel, or other nonporous corrosion resistant material of suitable dimensions to...”

“Vertical wells must be placed so as not to endanger underlying liners and must address the occurrence of water within the landfill. Holes and trenches constructed for piped wells and horizontal collectors must be...”³⁴

The EPA states landfills shall “operate the system such that all collected gases are vented to a control system...”, and “operate the control or treatment system at all times when the collected gas is routed to the system.”³⁵

The EPA states that “an active collection system shall be designed to handle the maximum expected gas flow rate from the entire area of the landfill”, and “be designed to minimize off-site migration of subsurface gas.”³⁶

Proposed

The proposed rule incorporates the state requirements established by RCW 70A.540.040(3) into the rule for gas leak limits for GCCSs.

The proposed rule incorporates the above federal language.

³³ [eCFR :: 40 CFR 60.763 -- Operational standards for collection and control systems.](#)

³⁴ [eCFR :: 40 CFR 62.16728 -- Specifications for active collection systems.](#)

³⁵ [eCFR :: 40 CFR 62.16716 -- Operational standards for collection and control systems.](#)

³⁶ [eCFR :: 40 CFR 62.16714 -- Standards for municipal solid waste landfill emissions.](#)

Owners and operators must satisfy the following requirements when operating a GCCS:

- “Route the collected gas to a gas control device or devices and operate the GCCS continuously...”
- “The GCCS must be designed and operated to draw all the gas toward the gas control device or devices.”

Expected impact

No impact because the proposed rule does not add any requirements in excess of the baseline.

2.3.1.5 Methane destruction efficiency requirements for flares and energy recovery control devices

Baseline

State law

The authorizing statute RCW 70A.540.040 stipulates requirements for methane destruction efficiency of gas control devices, including:

- Enclosed flares must achieve 99% destruction of methane.
- Open flares are to be phased out, but operated in the interim in accordance with the federal rule 40 C.F.R. Sec. 60.18
- Energy recovery devices must be 97% efficient at methane destruction, except for lean-burn internal combustion engines that were installed and operating prior to January 1, 2022.³⁷

Federal requirements

The EPA focuses on non-methane organic compounds (NMOC), requiring 98% destruction, but requires landfill surface methane to be below 500 ppmv.

Open flares are required to be operated with “no visible emissions”. Enclosed control devices, including enclosed flares must reduce NMOC by 98% by weight.³⁸

Proposed

The efficiency requirements of methane destruction devices in the proposed rule are the same as in the authorizing statute RCW 70A.540.

Expected impact

No impact because the proposed rule does not add any requirements in excess of the baseline.

³⁷ These types of control devices must reduce the outlet methane concentration to less than 3,000 ppmv, dry basis corrected to 15% oxygen.

³⁸ [eCFR :: 40 CFR 63.1959 -- NMOC calculation procedures.](#)

2.3.1.6 Requirements for open flare systems

Baseline

State law

The authorizing statute, specifically RCW 70A.540.040(4) establishes the requirements for open flares.

Open flares operating before December 31, 2022, may be operated until January 1, 2032, unless the landfill's HIC is below 3,000,000 BTU/hr, and gas flow is insufficient to support an enclosed flare or other gas control device. There are also provisions for temporary use of open flares.

Federal law

EPA allows for open flaring and specifies that they be operated with no visible emissions, in accordance with 40 C.F.R. Sec. 60.18.

Proposed

The proposed rule incorporates the requirements from the state law.

Expected impact

No impact.

2.3.1.7 Requirements for landfill gas treatment and processing

Baseline

State law

The authorizing statute, specifically RCW 70A.540.040(7) establishes the requirements for treatment and processing systems:

- The system must achieve a methane leak rate of three percent or less by weight.
- Venting of processed landfills gas to the ambient air is not allowed.
- Processed landfill gas that cannot be routed for subsequent sale or use must be flared.

Federal requirements

Federal regulations read "Route the collected gas to a treatment system that processes the collected gas for subsequent sale or beneficial use..."³⁹

Proposed

The proposed rule incorporates the requirements from the state law.

Expected impact

No impact.

³⁹ [eCFR :: 40 CFR 62.16714 -- Standards for municipal solid waste landfill emissions.](#)

2.3.1.8 Wellhead gauge pressure requirements

Baseline

State law

The authorizing statute RCW 70A.540.040(3) reads:

“The gas collection and control system must be designed and operated so that there is no landfill gas leak that exceeds 500 parts per million by volume, measured as methane, at any component under positive pressure.”

Federal requirements

Federal regulations read “Operate the collection system with negative pressure at each wellhead...”⁴⁰

Proposed

Wellhead gauge pressure requirement: Each wellhead must be operated under a vacuum (negative pressure). There are certain conditions specified in the proposed rule that exempt the owner or operator from having to comply with this requirement.

Expected impact

No impact. Wellheads are components of a GCCS, and the statute sets leak limits on components under positive pressure.

2.3.1.9 Requirements for devices measuring gauge pressure

Baseline

State law

The authorizing statute RCW 70A.540.080 reads:

“Gauge pressure must be determined using a hand-held manometer, magnehelic gauge, or other pressure measuring device approved by the department or local authority.”

Federal requirements

Federal regulations read: “...the owner or operator must measure gauge pressure in the gas collection header applied to each individual well monthly.”⁴¹ Specifications for equipment to be used meeting this requirement were not found.

Proposed

Determination of Gauge Pressure: Gauge pressure must be determined using a hand-held manometer, magnehelic gauge, or other pressure measuring device approved by Ecology or

⁴⁰ [eCFR :: 40 CFR 62.16716 -- Operational standards for collection and control systems.](#)

⁴¹ [eCFR :: 40 CFR Part 60 Subpart Cf -- Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills](#)

local authority. The device must be calibrated and operated in accordance with the manufacturer's specifications.

Expected impact

No impact. The requirements are consistent with EPA and industry operating procedures.⁴²

2.3.1.10 Requirements for instruments used to measure methane

Baseline

State law

The authorizing statute RCW 70A.50.080 reads:

“Any instrument used for the measurement of methane must be a hydrocarbon detector or other equivalent instrument approved by the department or local authority based on standards adopted by the department that address calibration, specifications, and performance criteria.”

Federal requirements

Landfills falling under federal regulations which require monitoring for surface methane must also use a hydrocarbon detector, calibrated using EPA reference method 21.⁴³

Proposed

- (1) Hydrocarbon Detector Specifications: Any instrument used for the measurement of methane must be a hydrocarbon detector or other equivalent instrument approved by the local authority that meets the calibration, specifications, and performance criteria of either WAC 173-408-120(1)(a) or WAC 173-408-120(1)(b), as applicable:
 - (a) EPA reference Method 21, Determination of Volatile Organic Compound Leaks, 40 CFR Part 60, Appendix A (as last amended 65 Fed.Reg. 61744 (October 17, 2000)), which is incorporated by reference herein, except for the following:
 - (i) Methane replaces all references to volatile organic compounds (VOC).
 - (ii) The calibration gas shall be methane.
 - (b) Other approved EPA test methods with concurrent department or local authority approval.

Expected impact

No impact. The use of a hydrocarbon detector for measuring methane is required by statute. There is no expected impact from the rule alone.

⁴² 40 CFR Appendix A-1 to Part 60

⁴³ 40 CFR 60.36f(d)(1)

2.3.1.11 Control device destruction efficiency calculation requirements

Baseline

State law

RCW 70A.540.080(6) stipulates that the control device's destruction efficiency must be determined by methods in the proposed rule.

Federal requirements

The EPA landfill gas regulations focus on non-methane organic compounds (NMOC). The federal rule requires that destruction devices reduce NMOCs by 98%. The federal rule specifies a suite of methods for determining the amount of organic gases present.^{44,45}

Proposed

The proposed rule adopts by reference EPA methodologies in determining the level of organic compounds in landfill gas. The rule specifies in WAC 173-408-120(6)(a) that one of the four EPA approved methods must be used.

Expected impact

The methane destruction efficiency requirements are set by statute. The methodology to determine that the requirements are met are set by the rule and adopted by reference from the EPA.

A larger number of landfills will fall under the rule than are currently covered by EPA regulation. Since under EPA rules NMOC is treated as a surrogate metric for landfill gas, the cost of these two calculations, destruction of methane versus NMOCs, Ecology assesses this standard to be equivalent with the federal standard.

The method set forth in the rule appears to be close to an industry standard and allows for the use of methodologies already used for existing federal regulations, but a greater number of landfills will need to calculate destruction efficiency of their control devices.

The benefit to these calculations is that owners and operators will know the destruction efficiency of their control devices, which will help them in meeting the statutory destruction efficiency requirements. Another benefit is that these calculations may help in determining whether equipment needs to be fixed or replaced. Better functioning equipment will lead to higher destruction efficiencies of methane.

⁴⁴ [https://www.ecfr.gov/current/title-40/part-60/section-60.752#p-60.752\(b\)\(2\)\(iii\)\(B\)](https://www.ecfr.gov/current/title-40/part-60/section-60.752#p-60.752(b)(2)(iii)(B))

⁴⁵ [https://www.ecfr.gov/current/title-40/part-60/section-60.754#p-60.754\(d\)](https://www.ecfr.gov/current/title-40/part-60/section-60.754#p-60.754(d))

2.3.1.12 Gas generation flow rate calculation requirements

Baseline

State law

RCW 70A.540.080 states that “The expected gas generation flow rate must be determined according to the department's implementing rules...”

Federal requirements

Federal regulations read “The flow rate of landfill gas, ... must be determined by measuring the total landfill gas flow rate at the common header pipe that leads to the control system using a gas flow measuring device calibrated according to the provisions of section 10 of EPA Method 2E of appendix A–1...”

And “the owner or operator may use another method to determine landfill gas flow rate and NMOC concentration if the method has been approved by the Administrator.”⁴⁶

Proposed

Determination of expected gas generation flow rate: the expected gas generation flow rate must be determined as prescribed by the 2006 IPCC Guidelines for National GHG Inventories, Chapter 3, which is incorporated by reference herein, using a recovery rate of 75 percent.

Expected impact

Creating this calculation initially will require labor, as will annual updates to this calculation.

The benefit of this calculation is that it will help owners and operators of MSW landfills forecast a timeline for continued operation of a GCCS.

2.3.1.13 Source testing requirements for any gas control device or devices (GCDs)

Baseline

State Law

RCW 70A.540.040(8) specifically sets source testing as a requirement and mandates its frequency.

“If a gas control device is currently not in compliance with source testing requirements as of June 9, 2022, or if a subsequent source test shows the gas control device is out of compliance, the owner or operator must conduct the source test no less frequently than once per year until two subsequent consecutive tests both show compliance. Upon two subsequent consecutive compliant tests, the owner or operator may return to conducting the source test no less frequently than once every five years.”

⁴⁶ [eCFR :: 40 CFR 62.16718 -- Test methods and procedures.](#)

Federal Requirements

EPA regulations refer to “performance testing” of GCDs and specify the reduction of NMOC by 98 percent. Their methods for measuring landfill gas are adopted by reference in this rule. Landfills with new GCDs must conduct a performance test within 180 days of installation.⁴⁷

Proposed

The proposed rule adopts, by reference, EPA established methods to determine amounts of organic compounds in landfill gas. The rule lists the approved methods in WAC 173-408-120(6) and are the same methods referenced to determine the destruction efficiency of gas control devices.

Landfills with a new GCCS must conduct a source test within 180 days of initial start-up of the GCCS. If the device is in compliance, testing need only occur once every five years.

Expected impact

Landfills required by statute to get new GCCSs will have to incur the expense of an initial source test.

Otherwise, the statute sets the general source testing requirement and frequencies. The methods allowed in the rule are adopted by reference and appear to be standard in the field.

The benefit from source testing is ensuring that a GCCS is operating at high efficiency and destroying as much methane as possible.

2.3.2 Monitoring Requirements:

2.3.2.1 Instantaneous and integrated surface emissions monitoring

Baseline

State law

RCW 70A.540.060 requires monitoring and allows for either instantaneous or integrated surface monitoring. The law requires landfills subject to surface monitoring requirements follow the procedures set forth in the proposed rule.

Federal requirements

EPA covered entities with a GCCS shall monitor the surface in a “pattern that traverses the landfill at 30-meter intervals (or a site-specific established spacing) for each collection area on a quarterly basis...”.⁴⁸ Furthermore, “...the probe inlet shall be placed within 5 to 10 centimeters of the ground. Monitoring shall be performed during typical meteorological conditions.”

⁴⁷ [https://www.ecfr.gov/current/title-40/part-60/subpart-WWW#p-60.752\(b\)\(2\)\(iii\)\(B\)](https://www.ecfr.gov/current/title-40/part-60/subpart-WWW#p-60.752(b)(2)(iii)(B))

⁴⁸ [https://www.ecfr.gov/current/title-40/part-60/section-60.755#p-60.755\(c\)](https://www.ecfr.gov/current/title-40/part-60/section-60.755#p-60.755(c))

Proposed

For both instantaneous and integrated surface monitoring, the landfill is to be divided into 50,000 ft² grids. Each grid is to be traversed starting with 25 ft spacing on a quarterly basis. The pattern can expand to 100 ft spacing after 4 quarters of no exceedances.

If the owner or operator can demonstrate that in the three years prior to adoption of this rule that there were no methane limit exceedances, by either annual or quarterly instantaneous surface emissions monitoring, then the pattern can expand to 100 ft spacing.

Closed landfills can go to annual monitoring after 4 quarters of no exceedances.

The hydrocarbon detector is to be held 3 inches from the landfill's surface.

Expected impact

A larger number of landfills will be required to monitor surface emissions, but that is determined by statute. Before reaching four quarters of no exceedances, landfills must be traversed with tighter spacing relative to the EPA's method, adding labor time and expense.

For the 15 landfills that fall below the federal threshold, the ongoing monitoring with a 100-foot grid is a cost attributable to the proposed rule.

The proposed rule's benefit would be increased detection of leaks, leading to more corrective action, which will lead to higher capture and destruction of methane.

Increased detection of leaks also has a public health benefit, as landfill gas contains toxic compounds, which if not collected and controlled may be emitted to the ambient air, potentially having negative impacts on surrounding communities.

2.3.2.2 Surface Monitoring Design Plan

Baseline

State law

None

Federal requirements

Federal regulations state "A surface monitoring design plan must be developed that includes a topographical map with the monitoring route and the rationale for any site-specific deviations from the 30-meter intervals. Areas with steep slopes or other dangerous areas may be excluded from the surface testing."⁴⁹

Proposed

A surface emissions monitoring design plan is required by this rule. It must include "a topographical map, at a minimum, with the monitoring traverse". It should also note "exempt areas, and the rationale for any site-specific deviations".

⁴⁹ [eCFR :: 40 CFR 62.16716 -- Operational standards for collection and control systems.](#)

Expected impact

The creation of this plan would require labor.

The benefit of this monitoring design plan is that it provides consistency and accountability. All impacted MSW landfills that conduct monitoring will need to submit a plan, and the plan will describe what areas need to be monitored or are exempt from monitoring.

2.3.2.3 Remonitoring and corrective action(s) for methane limit exceedances

Baseline

State law

RCW 70A.540.050(2) states that “any reading exceeding the limits set forth in subsection (1)⁵⁰ of this section must be recorded as an exceedance and the following actions must be taken:

- “The owner or operator must record the date, location, and value of each exceedance, along with retest dates and results. The location of each exceedance must be clearly marked and identified on a topographic map of the municipal solid waste landfill, drawn to scale, with the location of both the monitoring grids and the gas collection system clearly identified; and
- The owner or operator must take corrective action, which may include, but not be limited to, maintenance or repair of the cover, or well vacuum adjustments. The location or locations of any exceedance must be remonitored within 10 calendar days of a measured exceedance.”

Federal requirements

Federal regulations for remonitoring state:

- “If the re-monitoring of the location shows a second exceedance, additional corrective action must be taken, and the location must be monitored again within 10 days of the second exceedance.”⁵¹
- “If the re-monitoring shows a third exceedance for the same location, the action specified in ... of this section must be taken, and no further monitoring of that location is required until the action specified in paragraph ... of this section has been taken.”⁵²

Federal regulations for corrective action(s) state:

- “For any location where monitored methane concentration equals or exceeds 500 parts-per-million above background three times within a quarterly period, a new well or other collection device must be installed within 120 calendar days of the initial exceedance. An alternative remedy to the exceedance, such as upgrading the blower, header pipes

⁵⁰ 500 ppmv as determined by instantaneous surface emissions monitoring, or an average methane concentration limit of 25 ppmv as determined by integrated surface emissions monitoring.

⁵¹ [eCFR :: 40 CFR 62.16720 -- Compliance provisions.](#)

⁵² [eCFR :: 40 CFR 62.16720 -- Compliance provisions.](#)

or control device, and a corresponding timeline for installation may be submitted to the Administrator for approval.”⁵³

Proposed

Remonitoring:

- If the remonitoring of the location shows a second exceedance, additional corrective action must be taken, and the location must be remonitored again within 10 calendar days of the second exceedance.

Corrective action(s):

- Corrective action must be taken by the owner or operator such as, but not limited to, cover maintenance or repair, and well vacuum adjustments, and the location must be remonitored within 10 calendar days of a measured exceedance.
- If the remonitoring required by (the above) shows a third exceedance, the owner or operator must install a new or replacement well, or an alternative active methane control approved by the department or local authority, as needed to achieve compliance no later than 120 calendar days after detecting the third exceedance.

Expected impact

As statute calls out the first exceedance, corrective actions, and remonitoring, this section deals with a second and potentially third exceedance. A second exceedance remonitoring event would require additional time of personnel onsite, a minimal cost. The major cost would be a third exceedance at the same location, which would require the installation of a new or replacement well (or alternative active methane control) approved by ecology or local air authority.

The benefit of remonitoring and corrective action(s) is that they “close the loop” on found methane exceedances. This will provide for more expeditious and efficient capture and control of methane at MSW landfill sites.

This is also a benefit to public health, as corrective action(s) will mitigate the release of toxic compounds in landfill gas to the ambient air.

2.3.2.4 Gas collection and control system component monitoring

Baseline

State law

RCW 70A.540.060 stipulates gas control system monitoring requirements be set by rule.

⁵³ [eCFR :: 40 CFR 62.16720 -- Compliance provisions.](#)

Federal requirements

The EPA's rule for monitoring flare performance is similar to the proposed rule. The proposed rule does not specify how the bypass line connectors are to be configured, whereas the EPA's does.⁵⁴

Proposed

GCCS components containing landfill gas must be monitored quarterly for leaks.

Facilities must monitor and demonstrate that both open and enclosed flares are operated according to manufactures specifications. See the specific list of monitoring equipment above required for enclosed flares. (2.3.1.8)

Included in the requirements are a continuous temperature recorder, and gas input flow measurement device which records the flow rate at least every 15 minutes.

Expected impact

In addition to a greater number of facilities falling under regulation and being required to monitor flare temperatures and gas input flows, quarterly component leak testing will add labor costs relative to the EPA's rule⁵⁵. Benefits to monitoring would include less methane leakage over the lifespan of the equipment, as well as leakage of other compounds contained in landfill gas.

2.3.2.5 Methane leak rate limits for treatment systems that process routed gas

Baseline

State law

RCW 70A.540.040(7) sets the methane leak rate limit at 3 percent or less by weight for systems that process routed gas.

Federal requirements

EPA rules do not specify a leak rate limit for equipment designed to process gas for subsequent sale or use.

Proposed

The proposed rule incorporates the requirements in RCW 70A.540.040(7) into WAC 173-408-080.

Expected impact.

No impact.

⁵⁴ 40 CFR 60.37f(b)

⁵⁵ We assume facilities already have leak testing equipment in place.

2.3.2.6 Wellhead gauge pressure monitoring requirements

Baseline

State law

RCW 70A540.060(3) reads: “The owner or operator of a municipal solid waste landfill with a gas collection and control system must monitor each individual wellhead to determine the gauge pressure according to the requirements specified in implementing rules adopted by the department...”

Federal requirements

Landfills falling under federal GCCS requirements must monitor wellheads monthly for pressure, temperature as well as oxygen and nitrogen levels.^{56,57}

Proposed

The owner or operator of a MSW landfill with a gas collection and control system must monitor each individual wellhead monthly to determine the gauge pressure. If there is any positive pressure reading the owner / operator must take corrective action.

Expected impact

The proposed rule’s lower thresholds for GCCS requirements will require more landfills to have wells and monitor wellheads for positive pressure accordingly. Increased monitoring increases the likelihood of identifying leaks and decrease the duration of a leak.

For those already covered by the federal requirements there would be no change and therefore no impact.

The benefit of this is that it will identify improper operation of wellheads and associated equipment, which will lead to corrective action(s) and decreased leaks of methane and other landfill gas from wellheads.

2.3.2.7 Requirements for shutdown and removal of the GCCS

Baseline

State law

RCW 70A.540.090 states that Ecology or the local clean air agency must allow for the capping or removal of a GCCS at a closed MSW landfill, provided the following requirements are met:

- The GCCS was in operation for at least 15 years, unless the owner or operator can demonstrate to the satisfaction of Ecology or the local clean air agency that they are unable to do so due to declining methane rates.

⁵⁶ [https://www.ecfr.gov/current/title-40/part-60/section-60.766#p-60.766\(a\)](https://www.ecfr.gov/current/title-40/part-60/section-60.766#p-60.766(a))

⁵⁷ [https://www.ecfr.gov/current/title-40/part-60/section-60.37f#p-60.37f\(a\)](https://www.ecfr.gov/current/title-40/part-60/section-60.37f#p-60.37f(a))

- Surface methane concentration limits do not exceed the limits specified in RCW 70A.540.050.
- The owner or operator submits an equipment removal report.

Federal requirements

The EPA mandates that GCCS systems operate for 15 years, or that landfill operators demonstrate there is insufficient methane for operation. Each owner or operator of a controlled landfill must submit an equipment removal report to the Administrator 30 days prior to removal or cessation of operation of the control equipment.⁵⁸

The EPA also mandates that prior to capping, removal, or decommissioning of a GCCS, landfills calculate the NMOC emissions rate, and that the “rate at the landfill is less than 34 megagrams per year on three successive test dates. The test dates must be no less than 90 days apart, and no more than 180 days apart.”⁵⁹

Proposed

- The GCCS was in operation for at least 15 years, unless the owner or operator can demonstrate to the satisfaction of Ecology or the local clean air agency that they are unable to do so due to declining methane rates.
- The owner or operator of the landfill conducts a provisional shutdown of the collection and control system and conducts surface emissions monitoring over the portion of the landfill served by the shut-down gas collection and control system for at least eight consecutive calendar quarters.
 - During the provisional shutdown period, the surface emissions monitoring walking grid may be increased to 100-foot spacing so long as the walking grid is offset by 25 feet each quarter so that by the end of one year of monitoring, the entire surface area has been monitored every 25 feet.
- During provisional shutdown, if there is any measured concentration of methane from the surface of the landfill that exceeds the limits specified in RCW 70A.540.050 then the owner or operator must restart the shut-down portion of the GCCS.
- The owner or operator must submit an equipment removal report.

Expected impact

This provision would require an additional 8 quarters of monitoring at 100-foot spacing.

The proposed rule’s benefit would be increased detection of leaks, leading to more corrective action, which will lead to higher capture and destruction of methane.⁶⁰

⁵⁸ [https://www.ecfr.gov/current/title-40/part-60/subpart-Cf#p-60.38f\(g\)](https://www.ecfr.gov/current/title-40/part-60/subpart-Cf#p-60.38f(g))

⁵⁹ [eCFR :: 40 CFR 62.16714 -- Standards for municipal solid waste landfill emissions.](#)

⁶⁰ A 2015 analysis by Eastern Research Group showed that the smaller (25-foot) monitoring grid resulted in increased exceedances detected.

Increased detection of leaks also has a public health benefit, as landfill gas contains potentially toxic compounds, which if not collected and controlled are emitted to the ambient air.

2.3.3 Reporting and Recordkeeping Requirements:

2.3.3.1 Waste in place reporting requirements

Baseline

State law

The statute RCW 70.540.030 requires landfill operators with less than 450,000 tons of waste in place must submit a waste in place (WIP) annually.

Federal requirements

Waste in place (WIP) measures are part of landfill design plan submissions under federal rules.

Landfills that exceed 2.5 million metric tons must submit an initial design report and calculate an estimate of NMOC emissions along with an estimate of WIP⁶¹. If those emissions are estimated to be less than 34 megagrams per year and are projected to remain under 34 megagrams for the next five years, they are only required to submit NMOC reports every 5 years. If their emissions exceed 34 megagrams per year, they fall under expanded regulation and likely requirements to install a GCCS.⁶²

Proposed

Each landfill operator that received solid waste after Jan 1, 1992, must submit an initial waste in place report (WIP). Landfills with less than 450k tons of WIP must submit reports annually thereafter until either they exceed 450k tons and fall under expanded regulation, or they submit a closure notification.

Expected impact

No impact. By statute RCW 70A.540 landfills with less than 450k tons of WIP will have to submit annual waste in place reports. We estimate there are 13 of these. There is no additional cost from the rule.

2.3.3.2 Landfill gas heat input capacity calculation and reporting requirements

Baseline

State law

Active landfills with at least 450,000 tons of waste in place must make an initial heat input capacity (HIC) calculation and update it annually until an estimate of 3,000,000 BTU / hr is

⁶¹ 40 CFR §§ 60.38f(c)(3), 60.767(b)(1)(ii)

⁶² <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-60/subpart-Cc/section-60.35c>

reached, or the landfill is closed. They must report this number annually to the local authority or Ecology.⁶³

Federal requirements

For most landfills with greater than 2.5 million metric tons, and 2.5 million cubic meters, the EPA requires an initial non-methane organic carbon (NMOC) calculation. If that calculation shows less than 34 megagrams per year of NMOC are being emitted, the calculation must be repeated each year until the landfill closes, or it exceeds the threshold. If the threshold is exceeded, the landfill must install a GCCS.⁶⁴

Proposed

WAC 173-408 incorporates the statute (RCW 70A.540.030) into the rule.

Expected impact

No Impact

2.3.3.3 Surface emissions monitoring reporting

Baseline

State law

None

Federal requirements

“If the owner or operator elects to demonstrate that site-specific surface methane emissions are below 500 parts-per-million methane, based on the provisions of ... then the owner or operator must submit annually a Tier 4 surface emissions report ... until a surface emissions reading of 500 parts per million of methane or greater is found.”⁶⁵

“If the Tier 4 surface emissions report shows no surface emissions readings of 500 parts-per-million methane or greater for four consecutive quarters at a closed landfill, then the landfill owner or operator may reduce Tier 4 monitoring from a quarterly to an annual frequency.”⁶⁶

“The Tier 4 surface emissions report must clearly identify the location, date and time (to the nearest second), average wind speeds including wind gusts, and reading (in parts-per-million) of any value 500 parts-per-million methane or greater, other than non-repeatable, momentary readings. For location, you must determine the latitude and longitude coordinates using an instrument with an accuracy of at least 4 meters. The coordinates must be in decimal degrees with at least five decimal places.”⁶⁷

⁶³ <http://app.leg.wa.gov/RCW/default.aspx?cite=70A.540.030>

⁶⁴ 40 CFR 60.33c(e)(1)(ii)

⁶⁵ [eCFR :: 40 CFR 62.16724 -- Reporting guidelines.](#)

⁶⁶ [eCFR :: 40 CFR 62.16724 -- Reporting guidelines.](#)

⁶⁷ [eCFR :: 40 CFR 62.16724 -- Reporting guidelines.](#)

Proposed

Any owner or operator who conducts surface emissions monitoring must include the following information in an annual report:

- Dates(s) of monitoring.
- Location of monitoring grid coordinates, as well as coordinates of areas exempted from monitoring, on a topographic map.
- Measured concentration of methane in ppmv, exceedances, and all corrective actions taken.

Expected impact

This reporting will require 2 to 3 days of labor.

The benefit to surface emissions monitoring reporting is providing accountability and transparency. The report will compile important metrics on surface emissions monitoring operations at MSW landfill sites, including locations on all exceedances and corrective action(s) taken.

2.3.3.4 Gas collection and control system operations reporting

Baseline

State law

None

Federal requirements

None

Proposed

Owners and operators of MSW landfills must report on their GCCS operations annually. This report includes total volume of landfill gas collected; average composition of landfills gas; gas control device type and specifications; date of GCCS installation; methane destruction efficiency; type and amount of supplemental fuels burned; total volume of landfill gas shipped offsite; and a copy of the most recent source test for each gas control device.

Expected impact

Meeting this requirement is estimated to take 2 hours per week to track all of the required information and 20 hours to bring it together for annual submission.

The benefit of this report is that it provides and compiles important information on the operations of each GCCS, which helps in determining whether this equipment is operating as required.

2.3.3.5 Records maintenance requirements related to monitoring, source testing, landfill operations, operation of the GCCS, methane level exceedances, and actions involving the disturbance or removal of areas of the landfill surface

Baseline

State law

RCW 70A.540.070 reads: “The owner or operator of a municipal solid waste landfill must maintain records related to monitoring, (source) testing, landfill operations, and the operation of the gas control device, gas collection system, and gas control system. The records must be provided by the owner or operator to the department or local authority within five business days of a request from the department or local authority.”

It does not specify the length of record retention and states landfill owners and operators are to comply with requirements set by rule.

Federal requirement

Landfills under EPA regulation are required to maintain records identical to the proposed rule. The retention period is for 5 years⁶⁸.

Proposed

For 5 years records must be maintained in 16 different categories, including the monitoring of surface methane emissions, the operational performance of gas control systems and well pressure. Records also must be maintained on disturbances of landfill cover material, waste acceptance rates and WIP, along with any significant operational disturbances.

Additionally, for the life of each gas control device, the operator must maintain records of performance parameters including estimates of gas destruction efficiency and the vendors original operational specifications and source testing results.

Expected impact

Landfills currently under EPA regulation will face no additional reporting costs. Landfills subject only to the proposed rule will incur expenses to meet record keeping requirements. Those general categories are specified in the statute quoted above. The specific requirements of the rule add clarity and are estimated to add no cost.

The benefit of recordkeeping is that it provides accountability. For example, these records will show whether a GCCS has been operating as required and will also show methane exceedances and subsequent corrective action(s) taken to mitigate these exceedances.

2.3.3.6 Reporting for capping of landfill gas collection wells, removal or cessation of gas collection and control system equipment

Baseline

State Law

RCW 70A.540.090 stipulates the requirements for removal of GCCSs or their components.⁶⁹

⁶⁸ <https://www.ecfr.gov/current/title-40/section-60.39f>

⁶⁹ <http://app.leg.wa.gov/RCW/default.aspx?cite=70A.540.090>

It requires that the system be in operation for 15 years and that surface methane concentrations not exceed 500 ppmv.

Federal Requirements

The EPA mandates that GCCS systems operate for 15 years, or that landfill operators demonstrate there is insufficient methane for operation. Each owner or operator of a controlled landfill must submit an equipment removal report to the EPA 30 days prior to removal or cessation of operation of the control equipment.⁷⁰

Proposed

WAC 173-408-090 incorporates the statute into the rule.

“Equipment Removal Report: The owner or operator of a MSW landfill must submit a gas collection and control system equipment removal report to the local authority within 30 days of well capping or the removal or cessation of operation of the gas collection, treatment, or control system equipment.” The required information includes a copy of the closure report for the landfill, a copy of the original source test and evidence that the GCCS system has operated for 15 years, or no longer produces sufficient methane to operate the GCCS correctly. Additionally, eight quarters of monitoring data showing surface methane levels are under limits set in this rule are required.

Expected impact

No impact.

2.3.3.7 Landfill closure reporting to Ecology or local clean air agency

Baseline

State law

RCW 70A.540.070(3) reads: “The owner or operator of a municipal solid waste landfill that ceases to accept waste must submit a closure notification to the department or local authority within 30 days of ceasing to accept waste.”

Federal requirements

The EPA’s rules on landfill closure read in part: “Each owner or operator of a controlled landfill must submit a closure report to the Administrator within 30 days of ceasing waste acceptance..., no additional wastes may be placed into the landfill without filing a notification of modification as described under [§ 60.7\(a\)\(4\)](#).”⁷¹

Proposed

“Closure Notification Report: The owner or operator of an active MSW landfill that ceases to accept waste must submit a closure notification to the local authority within 30 days of ceasing to accept waste.” The notification the landfills submit will include: the last day waste was

⁷⁰ [https://www.ecfr.gov/current/title-40/part-60/subpart-Cf#p-60.38f\(g\)](https://www.ecfr.gov/current/title-40/part-60/subpart-Cf#p-60.38f(g))

⁷¹ [https://www.ecfr.gov/current/title-40/part-60/section-60.38f#p-60.38f\(f\)](https://www.ecfr.gov/current/title-40/part-60/section-60.38f#p-60.38f(f))

accepted, an estimate of the total waste in place (WIP), expected date of landfill closure. If the WIP is greater than 450,000 tons the landfill must submit projected HIC estimates for the next 30 years. Additional information may be requested to ensure the landfill is closed in accordance with regulations aside from this rule.

Expected impact

For landfills that are closing, the HIC calculation for the next 30 years will be a new cost to the closure notification report. The benefit would be greater awareness of the methane generation curve and planning timelines for the facility and Ecology.

2.3.4 Other Requirements

2.3.4.1 Incorporating new statutory civil penalties for violation of the law and implementing rules

Baseline

State law

RCW [70A.540.120](#) makes violating chapter RCW 70A.540 or the subsequent rule to implement it subject to civil penalty in the amounts specified in RCW [70A.15.3160](#). It states violators: "...may incur a civil penalty in an amount not to exceed ten thousand dollars per day for each violation...".

Proposed

Violations of any of Chapter 173-408 WAC constitutes a civil violation, the fine for which may not exceed \$10,000 per day per violation. The rule incorporates the statute.

Expected impact

No impact. The proposed rule language creates the same effect as the legislatively passed statute.

2.3.4.2 Maximum methane concentration limits for both owners and operators of active and closed MSW landfills

Baseline

State law

Washington's RCW 70A.540.050 specifies the surface methane concentration limits.

For facilities operating a GCCS, surface methane concentrations cannot exceed:

“(a) Five hundred parts per million by volume, other than nonrepeatable, momentary readings, as determined by instantaneous surface emissions monitoring; or

(b) An average methane concentration limit of 25 parts per million by volume as determined by integrated surface emissions monitoring. “

Federal requirements

The EPA's rule pertaining to methane surface concentration limits specifies any instantaneous reading above 500 ppmv as an exceedance.⁷²

Monitoring is required quarterly. There are no federal provisions for integrated surface monitoring.

Proposed

The proposed rule incorporates the surface methane emission limits from RCW 70A.540.050.

Expected impact

No impact.

2.3.4.3 Exemptions for methane concentration limit exceedances due to activities defined in RCW 70A.540.050(3)

Baseline

State law

RCW 70A.540.050(3) states that the methane concentration limits listed in this section of the law do not apply to:

- The working face of the landfill
- Areas of the landfills surface where the cover material has been removed for the purpose of installing, expanding, replacing, or repairing components of the landfill cover system, GCCS, leachate collection and removal system, or landfill has condensate collection and removal system.
- Areas of the landfill surface where the cover materials has been removed for law enforcement activities requiring excavation.
- Areas of the landfill in which the owner or operator, or designee, is engaged in active mining of minerals or metals.

Federal requirements

None

Proposed

The rule incorporates the statute.

Expected impact

No impact.

2.3.4.4 Establishing a method for landfills to claim exemption from the rule

Baseline

State law

RCW 70A.540.110 states “The department or local authority may request that any owner or operator of a municipal solid waste landfill demonstrate that a landfill does not meet the applicability criteria specified in the statute and rule. Such a demonstration must be submitted to the department or local authority within 90 days of a written request received from the department or local authority.

Federal requirements

None

Proposed

The rule incorporates the statute.

Expected impact

No impact

2.3.4.5 Establishing alternative compliance measures

Baseline

State law

RCW 70A.540.100 states that the owner or operator of a municipal solid waste landfill may request alternatives to the compliance measures, monitoring requirements, and test methods and procedures set forth in RCW [70A.540.040](#), [70A.540.060](#), and [70A.540.080](#), and the department's implementing rules adopted pursuant to RCW [70A.540.020](#). Any alternatives requested by the owner or operator must be submitted in writing to the department.

Federal requirements

None

Proposed

The rule incorporates the statute.

Expected impact

No impact.

Chapter 3: Likely Costs of the Proposed Rule

3.1 Introduction

We analyzed the likely costs associated with the proposed rule, as compared to the baseline. The proposed rule and the baseline are discussed in detail in Chapter 2 of this document.

3.2 Cost analysis

The proposed rule would impose the following requirements, some of which impose costs on regulated entities:

Technology and Performance Requirements:

- Gas collection and control system (GCCS) installation
- GCCS design plan
- Landfill gas control system equipment requirements
- GCCS performance requirements
- Adopting methane destruction efficiency requirements for flares and energy recovery control devices
- Adopting requirements for open flare systems
- Adopting requirements for landfill gas treatment and processing
- Wellhead gauge pressure requirements
- Requirements for devices measuring gauge pressure
- Requirements for instruments used to measure methane
- Control device destruction efficiency calculation requirements
- Gas generation flow rate calculation requirements
- Source testing requirements for any gas control device or devices

Monitoring Requirements:

- Instantaneous and integrated surface emissions monitoring
- Surface monitoring design plan
- Remonitoring and corrective action(s) for methane limit exceedances
- Gas collection and control system (GCCS) component monitoring
- Adopting methane leak rate limits for treatment systems that process routed gas
- Wellhead gauge pressure monitoring
- Requirements for shutdown and removal of the GCCS

Reporting and Recordkeeping Requirements:

- Waste in place reporting
- Landfill gas heat input capacity calculation and reporting
- Surface emissions monitoring reporting

- Gas collection and control system (GCCS) operations reporting
- Records maintenance for monitoring, source testing, landfill operations, operation of the GCCS, methane level exceedances, and actions involving the disturbance or removal of areas of the landfill surface
- Reporting for capping of landfill gas collection wells, removal, or cessation of GCCS equipment
- Landfill closure reporting to Ecology or the Local Clean Air Agency

Other Requirements:

- Incorporating new statutory civil penalties for violation of the law and implementing rules
- Adopting maximum methane concentration limits for both owners and operators of active and closed MSW landfills
- Adopting exemptions for methane concentration limit exceedances due to activities defined in RCW 70A.540.050(3)
- Establishing a method for landfills to claim exemption from the rule
- Establishing alternative compliance measures

3.2.1 Technology and performance Requirements

3.2.1.1 Gas collection and control system (GCCS) installation

This is not expected to add additional costs beyond the baseline. See section 2.3.1.1 for a discussion.

3.2.1.2 GCCS design plan

As discussed in section 2.3.1.2 above, while an estimated 15 landfills face new GCCS requirements, most of those requirements are specified in statute. One requirement in the proposed rule which is not specified in statute is to develop a GCCS design plan. Federal air emissions rules may already require a GCCS design plan for some landfills that will be covered under the proposed rule. For landfills with an existing design plan, their design plans will need to be reviewed and possibly amended for compliance with the requirements of the proposed rule. The cost of having a design plan prepared or reviewed and updated, and certified by a professional engineer, is attributable to the proposed rule.

It is estimated that design plan preparation and certification will require 90 to 120 hours of labor by an Environmental Engineer. The Department of Ecology has identified labor costs of \$119 per hour for Environmental Engineers⁷³.

⁷³ Personal communication with Lynnette Haller, September 7, 2023.

Table 1: Estimated costs for GCCS design plan preparation per landfill

Labor Type	Estimate	Hours	Wage	Total
Environmental Engineer	Low	90	\$ 119	\$ 10,710
Environmental Engineer	High	120	\$ 119	\$ 14,280

If a landfill already has all or part of a plan in place, they will not incur the full cost.

Ecology estimates 15 landfills will need to prepare an entire design plan, to be conservative, we are estimating total costs for a design plan even for those that may just need to be updated. The estimated cost for all 26 design plans (including those only requiring amendment) ranges from \$278,460 to \$371,280.

3.2.1.3 Landfill gas control system equipment requirements

Some landfills may need to purchase additional equipment or replace existing equipment under the proposed rule. New enclosed flare prices range from \$245,00 to \$395,000.⁷⁴ Some landfills may be able to modify their systems to comply with the rule. Monitoring systems for flares can cost over \$80,000.⁷⁵ As an illustrative example, if three landfills require new flares and five spend \$80,000 upgrading their equipment, the cost totals \$1.3 million. Actual costs will be site and situation specific.

3.2.1.4 GCCS performance requirements

This is not expected to add additional costs beyond the baseline. See section 2.3.1.4 for a discussion.

3.2.1.5 Methane destruction efficiency requirements for flares and energy recovery control devices

This is not expected to add additional costs beyond the baseline. See section 2.3.1.5 for a discussion.

3.2.1.6 Requirements for open flare systems

This is not expected to add additional costs beyond the baseline. See section 2.3.1.6 for a discussion.

3.2.1.7 Requirements for landfill gas treatment and processing

This is not expected to add additional costs beyond the baseline. See section 2.3.1.7 for a discussion.

3.2.1.8 Wellhead gauge pressure requirements

⁷⁴ https://www.johnzinkhamworthy.com/wp-content/uploads/tp_cost_effective_landfill_rev.pdf

⁷⁵ John L. Sorrels, Air Economics Group, OAQPS, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711

This is not expected to add additional costs beyond the baseline. See section 2.3.1.8 for a discussion.

3.2.1.9 Requirements for devices measuring gauge pressure

This is not expected to add additional costs beyond the baseline. See section 2.3.1.9 for a discussion.

3.2.1.10 Requirements for instruments used to measure methane

This is not expected to add additional costs beyond the baseline. See section 2.3.1.10 for a discussion.

3.2.1.11 Control device destruction efficiency calculation requirements

Landfills currently covered by EPA regulation are already required to do this. For those not currently covered, the GCCS is required by statute as are destruction efficiency calculations. The method is adopted by reference and taken to be industry standard. No cost comes from the rule.

3.2.1.12 Gas generation flow rate calculation requirements

It is estimated that for landfills that are not already doing this calculation, initial calculations could take up to 40 hours of labor by an environmental engineer, with an additional 16 hours of labor annually by an environmental engineer to update the calculation. The Department of Ecology has identified labor costs of \$119 per hour for Environmental Engineers⁷⁶.

Table 2: Estimated costs for flow rate calculation per landfill

Labor Type	Task	Hours	Wage	Total
Environmental Engineer	Initial Calculation	40	\$ 119	\$ 4,760
Environmental Engineer	Annual Revision	16	\$ 119	\$ 1,904

3.2.1.13 Source testing requirements for any gas control device or devices

Landfills need to conduct initial source testing of new a GCCS as specified in the statute. The method specified in the proposed rule⁷⁷ refers to published federal standards adopted by reference.⁷⁸ The rule adds no cost.

⁷⁶ Personal communication with Lynnette Haller, September 7, 2023.

⁷⁷ 173-408-120(6)(a)

⁷⁸ 40 C.F.R. Part 60, Appendix A

3.2.2 Monitoring requirements

3.2.2.1 Instantaneous and integrated surface monitoring requirements

While surface monitoring is required in both the Federal requirements and State law, the proposed rule requires a tighter initial grid than the Federal requirement, and State law does not specify a monitoring grid.

Until reaching four quarters of no exceedances, landfills must be traversed with tighter spacing relative to EPA requirements. This will cause landfills to incur additional estimated costs of \$376,000⁷⁹ due to the proposed rule.^{80,81,82} This applies to an estimated 26 landfills. The total cost is estimated at \$9,776,000 and would occur during the first year.

The need for this tighter initial grid, and the costs associated with it, can be avoided if an owner or operator of a MSW landfill can demonstrate that in the past three years before the effective date of the proposed rule that there were no measured exceedances by annual or quarterly instantaneous surface emissions monitoring.

For the 15 landfills that fall below the federal threshold, the ongoing monitoring with a 100-foot grid is a cost attributable to the proposed rule. These costs are estimated to be \$24,000 annually.⁸³

3.2.2.2 Surface monitoring design plan

It is estimated that creation of this plan could take up to 40 hours of labor by an environmental engineer. The Department of Ecology has identified labor costs of \$119 per hour for Environmental Engineers⁸⁴.

Table 3: Estimated costs for surface monitoring design plan preparation per landfill

Labor Type	Task	Hours	Wage	Total
Environmental Engineer	Initial Calculation	40	\$ 119	\$ 4,760

3.2.2.3 Remonitoring and corrective action(s) for methane limit exceedances

While we cannot assume exceedances, if they do occur, the second and beyond exceedances will have costs associated with them. A second exceedance remonitoring event would require additional time of personnel onsite, a minimal cost. The major cost would be a third exceedance at the same location, which would require the installation of a new or replacement well (or alternative active methane control) approved by ecology or local air authority. Costs would depend on the control method used.

⁷⁹ Per email from Art Mains, September 14, 2023.

⁸⁰ [Technical Support Document - Control of Methane Emissions from MSW Landfills - Final w appendices.pdf \(maryland.gov\)](#)

⁸¹ [EQC Staff Report \(oregon.gov\)](#)

⁸² [landfill Executive Order R-10-007 \(ca.gov\)](#)

⁸³ Per email from Art Mains, September 14, 2023.

⁸⁴ Personal communication with Lynnette Haller, September 7, 2023.

3.2.2.4 Gas collection and control system component monitoring

The proposed rule's lower thresholds for GCCS requirements will mean more facilities falling under regulation and being required to monitor flare temperatures and gas input flows, additionally, quarterly component leak testing will add labor costs relative to the EPA's rule. The specific costs for a facility would depend on the system they have in place. For example, if the system or parts of the system are under vacuum, component leak testing would be minimal, while other systems may require more extensive testing.

3.2.2.5 Methane leak rate limits for treatment systems that process routed gas

This is not expected to add additional costs beyond the baseline. See section 2.3.2.6 for a discussion.

3.2.2.6 Wellhead gauge pressure monitoring requirements

The proposed rule's lower thresholds for GCCS requirements will require more landfills to have wells. Wellhead pressure monitoring is required by statute. The rule specifications add minimal cost.

3.2.2.7 Requirements for shutdown and removal of the gas collection and control system

It is estimated that an additional eight quarters of monitoring at 100-foot intervals would cost roughly \$50,000. Note that this cost would only occur when the landfill shuts down.

3.2.3 Reporting and recordkeeping requirements

3.2.3.1 Waste in place reporting

This is not expected to add additional costs beyond the baseline. See section 2.3.3.1 for a discussion.

3.2.3.2 Landfill gas heat input capacity calculation and reporting requirements

This is not expected to add additional costs beyond the baseline. See section 2.3.3.2 for a discussion.

3.2.3.3 Surface emissions monitoring reporting

It is estimated that creation of this plan could take 16 to 24 hours of labor by an environmental engineer. The Department of Ecology has identified labor costs of \$119 per hour for Environmental Engineers⁸⁵.

⁸⁵ Personal communication with Lynnette Haller, September 7, 2023.

Table 4: Estimated costs for surface emissions monitoring reporting per landfill

Labor Type	Estimate	Hours	Wage	Total
Environmental Engineer	Low	16	\$ 119	\$ 1,904
Environmental Engineer	High	24	\$ 119	\$ 2,856

3.2.3.4 Gas collection and control system operations reporting

It is estimated that this requirement is estimated to take 2 hours per week by an environmental engineer to track all of the required information and 20 hours, again by an environmental engineer to bring it together for annual submission. The Department of Ecology has identified labor costs of \$119 per hour for Environmental Engineers⁸⁶.

Table 5: Estimated costs for gas collection and control system operations reporting

Labor Type	Hours	Wage	Total
Environmental Engineer	125	\$ 119	\$ 14,875

3.2.3.5 Records maintenance requirements related to monitoring, source testing, landfill operations, operation of the GCCS, methane level exceedances, and actions involving the disturbance or removal of areas of the landfill surface

This is not expected to add additional costs beyond the baseline. See section 2.3.3.5 for a discussion.

3.2.3.6 Reporting for capping of landfill gas collection wells, removal or cessation of gas collection and control system equipment

This is not expected to add additional costs beyond the baseline. See section 2.3.3.6 for a discussion.

3.2.3.7 Landfill closure reporting to Ecology or the local clean air agency

For landfills that are closing, the HIC calculation for the next 30 years will be a new cost to the closure notification report. As they report this calculation while in operation, the cost of calculating estimates for the 30-year period following closure would be minimal.

3.2.4 Other requirements

3.2.4.1 Incorporating new statutory civil penalties for violation of the law and implementing rules

This is not expected to add additional costs beyond the baseline. See section 2.3.4.1 for a discussion.

⁸⁶ Personal communication with Lynnette Haller, September 7, 2023.

3.2.4.2 Maximum methane concentration limits for both owners and operators of active and closed MSW landfills

This is not expected to add additional costs beyond the baseline. See section 2.3.4.2 for a discussion.

3.2.4.3 Exemptions for methane concentration limit exceedances due to activities defined in RCW 70A.540.050(3)

This is not expected to add additional costs beyond the baseline. See section 2.3.4.3 for a discussion.

3.2.4.4 Establishing a method for landfills to claim exemption from the rule

This is not expected to add additional costs beyond the baseline. See section 2.3.4.4 for a discussion.

3.2.4.5 Establishing alternative compliance measures

This is not expected to add additional costs beyond the baseline. See section 2.3.4.5 for a discussion.

3.3 Cost summary

The proposed rule creates two types of costs, one time and ongoing. The one-time costs include:

- GCCS design plan
- Gas generation flow rate calculation requirements
- Instantaneous and integrated surface monitoring requirements
- Surface monitoring design plan
- Surface emissions monitoring reporting

Ongoing costs include:

- Gas generation flow rate calculation requirements
- Surface emissions monitoring reporting
- Instantaneous and integrated surface monitoring requirements
- Gas collection and control system operations reporting

Table 6: Estimated one-time costs attributable to the proposed rule

Requirement	Low Estimated Cost	High Estimated Cost
GCCS design plan	\$10,710	\$14,280
Gas generation flow rate calculation requirements	\$4,760	\$4,760
Instantaneous and integrated surface monitoring requirements	\$376,000	\$376,000
Surface monitoring design plan	\$4,760	\$4,760
Total per landfill	\$396,230	\$399,800
Total for 26 landfills	\$10,301,980	\$10,394,800

Table 7: Estimated ongoing costs attributable to the proposed rule

Requirement	# of impacted landfills	Annual Cost Low Estimate	Annual Cost High Estimate
Gas generation flow-rate calculation requirements	26	\$1,904	\$1,904
Surface emissions monitoring reporting	26	\$1,904	\$2,856
Instantaneous and integrated surface monitoring requirements	15	\$24,000	\$24,000
Gas collection and control system operations reporting	26	\$14,875	\$14,875
Total for all landfills	26	\$845,758	\$870,744

The requirement that smaller landfills install GCCS systems, and many others in the proposed rule come from the statute, RCW 70A.540. The proposed rule adds costs for equipment upgrades, increased monitoring and GCCS design plans. Ecology estimates that the total one-time costs will be between roughly \$10.3 million to \$10.4 million. Additionally, the proposed rule causes Washington landfills to incur a total of nearly an estimated \$846,000 to \$871,000 in ongoing, annual costs. These costs bring a NPV of \$15.6 million to \$16 million over the 20-year

planning frame of the proposed rule⁸⁷. Combining these yields a total estimated cost range of \$25.9 million to \$26.4 million.

There are potential additional costs due to the proposed rule, however, these are site specific and estimating and aggregating them is nonviable.

⁸⁷ Discounted at a rate of 0.89%.

Chapter 4: Likely Benefits of the Proposed Rule

4.1 Introduction

We analyzed the likely benefits associated with the proposed rule, as compared to the baseline. The proposed rule and the baseline are discussed in detail in Chapter 2 of this document.

4.2 Benefits analysis

The primary benefits associated with the proposed rule are created by the following requirements:

Technology and Performance Requirements:

- Gas collection and control system (GCCS) installation
- GCCS design plan
- Landfill gas control system equipment requirements
- GCCS performance requirements
- Adopting methane destruction efficiency requirements for flares and energy recovery control devices
- Adopting requirements for open flare systems
- Adopting requirements for landfill gas treatment and processing
- Wellhead gauge pressure requirements
- Requirements for devices measuring gauge pressure
- Requirements for instruments used to measure methane
- Control device destruction efficiency calculation requirements
- Gas generation flow rate calculation requirements
- Source testing requirements for any gas control device or devices

Monitoring Requirements:

- Instantaneous and integrated surface emissions monitoring
- Surface monitoring design plan
- Remonitoring and corrective action(s) for methane limit exceedances
- Gas collection and control system (GCCS) component monitoring
- Adopting methane leak rate limits for treatment systems that process routed gas
- Wellhead gauge pressure monitoring
- Requirements for shutdown and removal of the GCCS

Reporting and Recordkeeping Requirements:

- Waste in place reporting
- Landfill gas heat input capacity calculation and reporting

- Surface emissions monitoring reporting
- Gas collection and control system (GCCS) operations reporting
- Records maintenance for monitoring, source testing, landfill operations, operation of the GCCS, methane level exceedances, and actions involving the disturbance or removal of areas of the landfill surface
- Reporting for capping of landfill gas collection wells, removal, or cessation of GCCS equipment
- Landfill closure reporting to Ecology or the Local Clean Air Agency

Other Requirements:

- Incorporating new statutory civil penalties for violation of the law and implementing rules
- Adopting maximum methane concentration limits for both owners and operators of active and closed MSW landfills
- Adopting exemptions for methane concentration limit exceedances due to activities defined in RCW 70A.540.050(3)
- Establishing a method for landfills to claim exemption from the rule
- Establishing alternative compliance measures

4.2.1 Technology and performance Requirements

4.2.1.1 Gas collection and control system (GCCS) installation

The benefit for the HIC calculation is getting an estimate of methane generation at MSW landfill sites, which will determine whether they need to collect and control methane onsite. Another benefit is consistency of methodology for all landfills making the calculation.

4.2.1.2 GCCS design plan

The benefit of a design plan is that it creates parameters for the proper and efficient operation of a GCCS, which will lead to more capture and control of methane.

The benefit of a professional engineer is that it provides accountability and consistency in regard to the preparation and certification of the design plan.

The benefit of an amended design plan is that it provides consistency so that all MSW landfills will have the same requirements for what should be included in their design plans.

Quantifying these benefits would be site and circumstance specific.

4.2.1.3 Landfill gas control system equipment requirements

Some of the landfills that previously fell below the EPA regulation threshold may need to purchase additional equipment or replace existing equipment under the proposed rule. The benefit of the monitoring equipment is it will allow for more continuous, efficient operation of the methane destruction device, it will also lead to safer operation of these gas control systems.

4.2.1.4 GCCS performance requirements

This is not expected to add additional benefits beyond the baseline. See section 2.3.1.4 for a discussion.

4.2.1.5 Methane destruction efficiency requirements for flares and energy recovery control devices

This is not expected to add additional benefits beyond the baseline. See section 2.3.1.5 for a discussion.

4.2.1.6 Requirements for open flare systems

This is not expected to add additional benefits beyond the baseline. See section 2.3.1.6 for a discussion.

4.2.1.7 Requirements for landfill gas treatment and processing

This is not expected to add additional benefits beyond the baseline. See section 2.3.1.7 for a discussion.

4.2.1.8 Wellhead gauge pressure requirements

This is not expected to add additional benefits beyond the baseline. See section 2.3.1.8 for a discussion.

4.2.1.9 Requirements for devices measuring gauge pressure

This is not expected to add additional benefits beyond the baseline. See section 2.3.1.9 for a discussion.

4.2.1.10 Requirements for instruments used to measure methane

This is not expected to add additional benefits beyond the baseline. See section 2.3.1.10 for a discussion.

4.2.1.11 Control device destruction efficiency calculation requirements

The benefit to these calculations is that owners and operators will know the destruction efficiency of their control devices, which will help them in meeting the statutory destruction efficiency requirements. Another benefit is that these calculations may help in determining whether equipment needs to be fixed or replaced. Better functioning equipment will lead to higher destruction efficiencies of methane.

4.2.1.12 Gas generation flow rate calculation requirements

The benefit of this calculation is that it will help owners and operators of MSW landfills forecast a timeline for continued operation of a GCCS.

4.2.1.13 Source testing requirements for any gas control device or devices

Primary benefit for source testing is ensuring compliance with the rule and statute thresholds which ensures 99 percent methane destruction.

4.2.2 Monitoring requirements

4.2.2.1 Instantaneous and integrated surface monitoring requirements

The proposed rule's benefit would be increased detection of leaks, leading to more corrective action, which will lead to higher capture and destruction of methane.⁸⁸

Increased detection of leaks also has a public health benefit, as landfill gas contains potentially toxic compounds, which may be emitted to the ambient air, potentially having negative impacts on surrounding communities.

4.2.2.2 Surface monitoring design plan

The benefit of this monitoring design plan is that it provides consistency and accountability. All impacted MSW landfills that conduct monitoring will need to submit a plan, and the plan will describe what areas need to be monitored or are exempt from monitoring.

4.2.2.3 Remonitoring and corrective action(s) for methane limit exceedances

The benefit of remonitoring and corrective action(s) is that they "close the loop" on found methane exceedances. This will provide for more expeditious and efficient capture and control of methane at MSW landfill sites.

This is also a benefit to public health, as corrective action(s) will mitigate the release of toxic compounds in landfill gas to the ambient air.

4.2.2.4 Gas collection and control system component monitoring

Benefits to monitoring would include less methane leakage over the lifespan of the equipment, as well as leakage of other component contained in landfill gas.

4.2.2.5 Methane leak rate limits for treatment systems that process routed gas

This is not expected to add additional benefits beyond the baseline. See section 2.3.2.6 for a discussion.

4.2.2.6 Wellhead gauge pressure monitoring requirements

The benefit of this is that it will identify improper operation of wellheads and associated equipment, which will lead to corrective action(s) and decreased leaks of methane and other landfill gas from wellheads.

⁸⁸ A 2015 analysis by Eastern Research Group showed that the smaller (25-foot) monitoring grid resulted in increased exceedances detected.

4.2.2.7 Requirements for shutdown and removal of the gas collection and control system

The proposed rule's benefit would be increased detection of leaks, leading to more corrective action, which will lead to higher capture and destruction of methane.⁸⁹

Increased detection of leaks also has a public health benefit, as landfill gas contains potentially toxic compounds, which if not collected and controlled are emitted to the ambient air.

4.2.3 Reporting and recordkeeping requirements

4.2.3.1 Waste in place reporting

This is not expected to add additional benefits beyond the baseline. See section 2.3.3.1 for a discussion.

4.2.3.2 Landfill gas heat input capacity calculation and reporting requirements

This is not expected to add additional benefits beyond the baseline. See section 2.3.3.2 for a discussion.

4.2.3.3 Surface emissions monitoring reporting

The benefit to surface emissions monitoring reporting is providing accountability and transparency. The report will compile important metrics on surface emissions monitoring operations at MSW landfill sites, including locations on all exceedances and corrective actions taken.

4.2.3.4 Gas collection and control system operations reporting

The benefit of this report is that it provides and compiles important information on the operations of each GCCS, which helps in determining whether this equipment is operating as required.

4.2.3.5 Records maintenance requirements related to monitoring, source testing, landfill operations, operation of the GCCS, methane level exceedances, and actions involving the disturbance or removal of areas of the landfill surface

The proposed rule will provide clarity on the requirements facilities face. Further, the benefit of recordkeeping is that it provides accountability. For example, these records will show whether a GCCS has been operating as required and will also show methane exceedances and subsequent corrective action(s) taken to mitigate these exceedances.

⁸⁹ A 2015 analysis by Eastern Research Group showed that the smaller (25-foot) monitoring grid resulted in increased exceedances detected.

4.2.3.6 Reporting for capping of landfill gas collection wells, removal or cessation of gas collection and control system equipment

This is not expected to add additional benefits beyond the baseline. See section 2.3.3.6 for a discussion.

4.2.3.7 Landfill closure reporting to Ecology or the local clean air agency

The closure report requires a 30 year HIC projection. Therefore, it will show the methanogenic curve at a landfill site which will require decreasing HIC/methane generation before a landfill can close and, in some cases, stop the operation of their GCCS, which will help with methane reduction.

4.2.4 Other requirements

4.2.4.1 Incorporating new statutory civil penalties for violation of the law and implementing rules

This is not expected to add additional benefits beyond the baseline. See section 2.3.4.1 for a discussion.

4.2.4.2 Maximum methane concentration limits for both owners and operators of active and closed MSW landfills

This is not expected to add additional benefits beyond the baseline. See section 2.3.4.2 for a discussion.

4.2.4.3 Exemptions for methane concentration limit exceedances due to activities defined in RCW 70A.540.050(3)

This is not expected to add additional benefits beyond the baseline. See section 2.3.4.3 for a discussion.

4.2.4.4 Establishing a method for landfills to claim exemption from the rule

This is not expected to add additional benefits beyond the baseline. See section 2.3.4.4 for a discussion.

4.2.4.5 Establishing alternative compliance measures

This is not expected to add additional benefits beyond the baseline. See section 2.3.4.5 for a discussion.

4.3 Overall Benefit

The benefits attributable to the proposed rule predominantly take the form of decreased methane emissions. Additional benefits include the collection and destruction of odiferous or toxic compounds (hydrogen sulfide and many others). The EPA states that, “burning landfill gas (LFG) to produce electricity destroys most of the non-methane organic compounds (including hazardous air pollutants and VOCs) that are present at low concentrations in uncontrolled LFG,

which reduces possible health risks from these compounds. In addition, gas collection can improve safety by reducing explosion hazards from gas accumulation in structures on or near the landfill.⁹⁰ Flaring LFG has similar benefits, as it also destroys toxic NMOCs.

For landfills that install energy recovery devices, energy will be created which can power their operations or be sold to the grid. This reduces the reliance on energy created from burning fossil fuel sources, such as coal and oil.

The proposed rule primarily creates benefits in the form of decreased emissions of methane. Estimating the benefits of the proposed rule requires estimating the impact it will have on improving the collection of methane and providing conversion of collected methane to beneficial uses or less potent greenhouse gases. To do this estimation, we used the impacts of the California Landfill Methane control regulation⁹¹ as a proxy. Under the California regulation, the collection and beneficial use of landfill methane as energy increased by 5%. The collection and conversion to less potent greenhouse gases by flaring of landfill methane increased by 33%.

Applying these percentage gains to the average of the last 5 years of methane captured in Washington yields an estimated increase of roughly .02 MMT of methane controlled annually due to the proposed rule. The social cost of methane is estimated at \$1,500 per ton⁹².

Therefore, the estimated benefits attributable to the proposed rule are \$32.3 million annually. These annual benefits bring a NPV of nearly \$595 million over the 20-year planning frame of the proposed rule⁹³. If only 10% of the benefits relative to the California regulation materialize, the estimated benefits will be nearly \$60 million.

⁹⁰ [Benefits of Landfill Gas Energy Projects | US EPA](#)

⁹¹ This regulation is comparable to the proposed rule and went into effect after 2001.

⁹² Interagency Working Group on Social Cost of Greenhouse Gases, 2021. Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990. United States Government.

Note that in November 2022, the US Environmental Protection Agency published new draft SCC values, reflecting updated methodology, climate science, and economic modeling. See https://www.epa.gov/system/files/documents/2022-11/epa_scghg_report_draft_0.pdf. The updated SCC values for a 2.5 percent discount rate begin at \$1,457 per metric ton of methane emitted in 2023, rising to \$2,995 by 2043. The report also presents SCC values for 2.0 percent and 1.5 percent, beginning at \$1,874 and \$2,564, respectively. For consistency, and because these draft values are not yet final, we have maintained a 2.5 percent discount rate throughout this analysis. Of the final Interagency Working Group discount rates, this 2.5 percent rate is the closest to the current long-run, risk-free rate of return based on US Treasury I Bonds (currently a 0.89 percent historic average). If final values were available for a lower discount rate that more closely matched the long-run, risk-free rate of return, we would use those SCC values and employ that discount rate throughout this analysis.

⁹³ Discounted at a rate of 0.89%.

Climate change disproportionately impacts the overburdened. Reducing GHGs therefore yields environmental justice benefits. These benefits range from decreased risk of wildfires⁹⁴ to a decrease in heat-related mortality⁹⁵.

⁹⁴ Even when wildfire smoke is ubiquitous, it impacts overburdened communities more severely, as they may not have good access to air filtration or non-emergency healthcare, and may need to spend more time outside during high heat events that often coincide, since they may have limited access to air conditioning and other cooling options.

⁹⁵ A study in British Columbia found that heat deaths in the greater Vancouver area were strongly tied to individuals' "material and social deprivation" as well as age, sex, and neighborhood greenness. Henderson, SB, KE McLean, MJ Lee, and T Kosatsky, 2022. Analysis of community deaths during the catastrophic 2021 heat dome. *Environmental Epidemiology* (2022) 6:e189. DOI: 10.1097/EE9.000000000000189.

Chapter 5: Cost-Benefit Comparison and Conclusions

5.1 Summary of costs and benefits of the proposed rule

The proposed rule adds costs for equipment upgrades, increased monitoring and GCCS design plans. Ecology estimates that the total one-time costs will be between roughly \$10.3 million to \$10.4 million. Additionally, the proposed rule causes Washington landfills to incur a total of nearly an estimated \$846,000 to \$871,000 in ongoing, annual costs. These costs bring a NPV of \$15.6 million to \$16 million over the 20-year planning frame of the proposed rule⁹⁶. Combining these yields a total estimated cost range of \$25.9 million to \$26.4 million.

There are potential additional costs due to the proposed rule, however, these are site specific and estimating and aggregating them is nonviable.

The proposed rule primarily creates benefits in the form of decreased emissions of methane. Estimating the benefits of the proposed rule requires estimating the impact it will have on improving the collection of methane and providing conversion of collected methane to beneficial uses or less potent greenhouse gases. To do this estimation, we used the impacts of the California Landfill Methane control regulation⁹⁷ as a proxy. Under the California regulation, the collection and beneficial use of landfill methane as energy increased by 5%. The collection and conversion to less potent greenhouse gases by flaring of landfill methane increased by 33%.

Applying these percentage gains to the average of the last 5 years of methane captured in Washington yields an estimated increase of roughly .02 MMT of methane controlled annually due to the proposed rule. The social cost of methane is estimated at \$1,500 per ton. Therefore, the estimated benefits attributable to the proposed rule are \$32.3 million annually. These annual benefits bring a NPV of nearly \$595 million over the 20-year planning frame of the proposed rule⁹⁸. If only 10% of the benefits relative to the California regulation materialize, the estimated benefits will be nearly \$60 million.

5.2 Conclusion

We conclude, based on a reasonable understanding of the quantified and qualitative costs and benefits likely to arise from the proposed rule, as compared to the baseline, that the benefits of the proposed rule are greater than the costs.

⁹⁶ Discounted at a rate of 0.89%.

⁹⁷ This regulation is comparable to the proposed rule and went into effect after 2001.

⁹⁸ Discounted at a rate of 0.89%.

Chapter 6: Least-Burdensome Alternative Analysis

6.1 Introduction

RCW 34.05.328(1)(c) requires Ecology to “...[d]etermine, after considering alternative versions of the rule and the analysis required under (b), (c), and (d) of this subsection, that the rule being adopted is the least burdensome alternative for those required to comply with it that will achieve the general goals and specific objectives stated under (a) of this subsection.” The referenced subsections are:

- (a) Clearly state in detail the general goals and specific objectives of the statute that the rule implements;
- (b) Determine that the rule is needed to achieve the general goals and specific objectives stated under (a) of this subsection, and analyze alternatives to rule making and the consequences of not adopting the rule;
- (c) Provide notification in the notice of proposed rulemaking under RCW 34.05.320 that a preliminary cost-benefit analysis is available. The preliminary cost-benefit analysis must fulfill the requirements of the cost-benefit analysis under (d) of this subsection. If the agency files a supplemental notice under RCW 34.05.340, the supplemental notice must include notification that a revised preliminary cost-benefit analysis is available. A final cost-benefit analysis must be available when the rule is adopted under RCW 34.05.360;
- (d) Determine that the probable benefits of the rule are greater than its probable costs, taking into account both the qualitative and quantitative benefits and costs and the specific directives of the statute being implemented.

In other words, to be able to adopt the rule, we are required to determine that the contents of the rule are the least burdensome set of requirements that achieve the goals and objectives of the authorizing statute(s).

We assessed alternative proposed rule content, and determined whether they met the goals and objectives of the authorizing statute(s). Of those that would meet the goals and objectives, we determined whether those chosen for inclusion in the proposed rule were the least burdensome to those required to comply with them.

6.2 Goals and objectives of the authorizing statute

The authorizing statute for this rule is Chapter 70A.540 RCW, Landfills – Methane Emissions. Its goals and objectives are to reduce methane emissions from MSW landfills by:

- Requiring an initial and annual waste in place reports from each owner or operator of an active municipal solid waste landfill having fewer than 450,000 tons of waste in place.
- Requiring calculations of landfill gas heat input capacity and landfill gas heat input capacity reports from each owner or operator of either an active municipal solid waste

landfill having greater than or equal to 450,000 tons of waste in place or a closed municipal solid waste landfill having greater than or equal to 750,000 tons of waste in place.

- Requiring the installation of gas collection and control systems for any municipal solid waste landfill that has a calculated landfill gas heat input capacity greater than or equal to 3,000,000 British thermal units per hour recovered. An exception being if a municipal solid waste landfill can demonstrate 4 consecutive quarterly monitoring periods that there is no methane concentration above 200 ppmv via instantaneous surface monitoring.
- Setting methane concentration limits and actions if an exceedance is reported.
- Setting monitoring requirements for landfill surfaces, gas collection and control system components, and wellheads.
- Setting recordkeeping, reporting, and testing methodology requirements.
- Adopting rules that are informed by landfill methane regulations adopted by the California air resources board, the Oregon environmental quality commission, and the United States environmental protection agency.

6.3 Alternatives considered and why they were excluded

We considered the following alternative rule content and did not include it in the proposed rule for the reasons discussed in each subsection below.

- Bimonthly surface emissions monitoring.
- Bimonthly GCCS components monitoring.
- Limit landfill working face and wet waste concentrations.
- Higher destruction efficiency.
- Exempting landfills that only accepted waste for part of 1992.
- Full exemption for landfills regulated under CERCLA.
- Not including wind speed requirements for monitoring.
- Increasing the monitoring traverse spacing.
- Approving ALT-150 for compliance.
- Making all required records available to the public and air agencies.
- Requiring a surface monitoring report after 4th consecutive quarterly monitoring period.
- Requiring landfills to record surface emissions exceedances over 100 ppmv.
- Not easing the monitoring traverse.
- Requiring monthly monitoring for specific areas.

- Creating gas shipping requirements.

6.3.1 Bimonthly surface emissions monitoring.

We considered bimonthly surface emissions monitoring, instead of quarterly or annually, and the use of remote sensing technology for measurement. However, bimonthly monitoring departs from California Air Resources Board (CARB)⁹⁹, Oregon (OR)¹⁰⁰, and the Environmental Protection Agency's (EPA)¹⁰¹ existing rules, which our rules need to be consistent with, and would create an economic burden. We do allow for alternative monitoring methods, upon concurrent approval from Ecology or the local clean air agency, but do not require it as these technologies are expensive to use.

6.3.2 Bimonthly GCCS component monitoring.

Our gas collection and control system component monitoring standard is a quarterly requirement, which aligns with CARB, OR and EPA requirements. To require monitoring six times more frequently than these other existing standards would impose heavy costs, and there is not enough existing data to suggest monitoring at this frequency would provide substantial benefit.

6.3.3 Limit landfill working face and wet waste concentrations.

We considered including requirements to limit the landfill working face, limit the concentration of wet waste, and speed up the installation of intermediate cover. However, Ecology does not believe the alternative for limiting the working face was feasible based on prior federal and state requirements, which already require 6 inches of daily cover to be placed over the working face of a landfill at the end of their daily operations. We also do not believe it to be practical to limit wet waste concentrations, as landfills operating on the west side of the state receive heavy amounts of precipitation. We require monitoring and corrective action(s) for any exceedances, with the exception of the working face, active mining, and law enforcement activities. Any methane exceedances will be found and reported through monitoring requirements.

6.3.4 Higher destruction efficiency.

We considered implementing higher destruction efficiency requirements for treatment systems; however, our statute requires a three percent or less leak rate by weight for landfill gas that is routed for processing and treatment, and we have decided to adopt statutory language on this rule. Destruction efficiency for flares is 99%.

⁹⁹ [landfillfinalfro Methane Emissions from Municipal Solid Waste Landfills Regulation \(ca.gov\)](#)

¹⁰⁰ [Oregon Secretary of State Administrative Rules](#)

¹⁰¹ [FINAL UPDATES TO PERFORMANCE STANDARDS FOR NEW, MODIFIED AND RECONSTRUCTED LANDFILLS, AND UPDATES TO EMISSION GUIDELINES FOR EXISTING LANDFILLS: FACT SHEET \(epa.gov\)](#)

6.3.5 Exempting landfills that only accepted waste for part of 1992.

Our statute sets a clear requirement for applicability: all MSW landfills that have received solid waste after January 1st, 1992. We do not have discretion to change this requirement. Landfills that received waste after this date are unable to obtain an exemption based on receiving waste for only part of the year before closing.

6.3.6 Full exemption for landfills under CERCLA.

There are large MSW landfill sites that have had past or ongoing CERCLA (Superfund) response actions onsite. We considered giving these landfills full exemption; however, we feel that giving these landfills a blanket exemption from the rule would deviate from the goal of our authorizing statute, which is to reduce methane emissions from MSW landfills. We did, however, create a process for MSW landfills with CERCLA response actions onsite to claim partial exemption from the rule, which would exempt them from having to monitor and report on areas of the landfills that fall under CERCLA.

6.3.7 Not including wind speed requirements for monitoring.

We require the termination of monitoring events when speeds are high enough to alter readings. Not including any parameters for wind speed as part of our monitoring requirements could create a loophole where monitoring results taken on windy days are not an accurate depiction of on-the-spot methane detection. This would not have met the goals of the statutory requirements. We allow for alternative compliance measures for landfills that consistently experience heavy winds, as well as alternative monitoring methods that are EPA approved and less impacted by wind.

6.3.8 Increasing the monitoring traverse spacing.

We considered using larger monitoring traverse spacings, however, both CARB and OR have adopted rules requiring a 25-ft spacing traverse, and we believe that we would not be meeting the requirements of our statute if we did not align with this major monitoring requirement. Along with CARB and OR, we do allow an easing of this monitoring traverse (to 100-ft spacing) if a MSW landfill demonstrates no exceedances over four consecutive quarterly monitoring periods of the 25-ft spacing. Further, if a MSW landfill can demonstrate, in the three years prior to adoption of the rule, that there are no methane exceedances during annual or quarterly monitoring events, the monitoring traverse can be increased to 100-ft spacing. This is an incentive for landfills to make sure their operations and equipment are working efficiently, and if they are they can start monitoring under the eased monitoring traverse.

6.3.9 Approving OTM-51/ALT-150 for compliance.

Alternative Test Letter 150 (ALT-150)¹⁰², issued by the EPA, contains caveats and conditional use for Other Test Method 51 (OTM-51).¹⁰³ One of the conditions is that this technology be approved by a local clean air agency before it can be used. In our rule we allow this technology to be used under conditional approval, which meets the intention of ALT-150. We also believe that it is better to allow the use of this technology as an alternative compliance option, because if the EPA decides at a later date that this technology does not meet the standards of Method 21 (the common monitoring method) then we would have to amend our rule based on this determination.

6.3.10 Making all required records available to the public and local clean air agencies.

We considered requiring more records be submitted to Ecology but determined that it would be more burdensome to compliant parties. Private entities have no obligation to provide records in response to requests from members of the public. However, any records that are held by Ecology or the local clean air agencies as part of this rule can be requested through the public records request process. Regarding reports, the required annual report must go to both Ecology and the clean air agencies per statutory requirements.

6.3.11 Requiring a surface monitoring report after the 4th consecutive quarterly period.

Our statute requires an annual report, which is based off the previous calendar year. To add a report that would not cover the whole of the calendar year would not meet the intent of the statute, and it would also add undue burden to owners and operators of MSW landfills as they would not have a set, concrete annual reporting date.

6.3.12 Requiring landfills to record surface emissions exceedances over 100 ppmv.

Our statute requires recordkeeping for exceedances of 200 ppmv or over, going with the 100 ppmv exceedance would deviate from the direction provided in statute.

6.3.13 Not easing the monitoring traverse.

We considered permanently requiring surface monitoring with 25-ft spacing intervals, regardless of exceedance frequency, however, allowing a 100-ft monitoring grid traverse for landfills that can demonstrate no exceedances over four consecutive quarterly monitoring

¹⁰² [ALT-150 Approval to Use Unmanned Aerial System Application as an Alternative to Method 21 for Surface Emission Monitoring of Landfills](#)

¹⁰³ [Other Test Method 51 \(OTM-51\) - UAS Application of Method 21 for Surface Emission Monitoring of Landfills](#)

periods at 25-ft spacing aligns with both CARB and OR requirements. Not easing the monitoring traverse would also add a heavy burden to landfills that have not shown any monitoring exceedances as they would need to continue to conduct monitoring at four times the traverse, even if they have shown no exceedances.

6.3.14 Requiring monthly monitoring for specific areas.

We considered requiring monthly monitoring for cover penetrations, distressed vegetation, cracks, and seeps; however, we already require monitoring of these areas quarterly, which aligns with quarterly monitoring of the rest of the landfill surface. To require a monthly monitoring schedule for these specific areas would deviate from the CARB and OR requirements and would also add an economic burden to landfills who would have to schedule both monthly and quarterly monitoring of their landfills for different locations.

6.3.15 Creating gas shipping recording requirements.

We considered having gas shipping recording requirements; however, we believe that this recordkeeping requirement is unnecessary as the intention of this rule is to decrease any methane leaks from landfills and third-party owners and operators who may have obtained or purchased the gas from landfills. Once the gas is sold and shipped offsite or put into a pipeline it is no longer covered by the scope of this rule.

6.4 Conclusion

After considering alternatives to the proposed rule's contents, within the context of the goals and objectives of the authorizing statute, we determined that the proposed rule represents the least-burdensome alternative of possible rule contents meeting the goals and objectives.

Chapter 7: Regulatory Fairness Act Compliance

The Regulatory Fairness Act (RFA; RCW 19.85.070) requires Ecology to perform a set of analyses and make certain determinations regarding the proposed rule.

A small business is defined by the RFA as having 50 or fewer employees, at the highest ownership and operator level. Estimated compliance costs are determined as compared to the baseline (the regulatory environment in the absence of the proposed rule, limited to existing federal and state requirements). Analyses under the RFA only apply to costs to “businesses in an industry” in Washington State. This means the impacts, for this part of our analyses, are not evaluated for government agencies.

Five private businesses would be required to comply with the proposed rule. None of these businesses are a small business at the highest ownership and operator level as defined by the RFA. The employment of the businesses ranges from 120 to 140,500 employees.

We conclude that since the rule does not impose compliance costs on small businesses, we are exempt from the regulatory fairness act under RCW 19.85.0254(4), which states that this chapter does not apply to the adoption of a rule if an agency is able to demonstrate that the proposed rule does not affect small businesses.

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Appendix A: Administrative Procedure Act (RCW 34.05.328) Determinations

- A. RCW 34.05.328(1)(a) – Clearly state in detail the general goals and specific objectives of the statute that this rule implements.**

See Chapter 6.

- B. RCW 34.05.328(1)(b) –**

- 1. Determine that the rule is needed to achieve the general goals and specific objectives of the statute.**

See chapters 1 and 2.

- 2. Analyze alternatives to rulemaking and the consequences of not adopting this rule.**

Chapter 70A.540 RCW authorizes Ecology to adopt new rules that will impact active and closed municipal solid waste (MSW) landfills that have received solid waste after January 1st, 1992. The rules Ecology adopts will establish new recordkeeping, reporting, monitoring, and technology installation, as well as other possible requirements.

Chapter 70A.540.020(3) requires Ecology to adopt rules to implement Chapter 70A.540 RCW, Landfills – Methane Emissions. RCW 70A.540.050(1) requires that, beginning January 1st of the year after Ecology adopts rules, or upon commencing operation of a newly installed gas collection and control system or modification of an existing system, whichever is later (not to exceed 24 months after adoption of this rulemaking), no location on a MSW landfill surface may exceed the following methane concentration limits:

- Five hundred parts per million by volume, other than nonrepeatable, momentary readings, as determined by instantaneous surface emissions monitoring; or
- An average methane concentration limit of 25 parts per million by volume as determined by integrated surface emissions monitoring.

If these methane concentration limits are exceeded, owners or operators of MSW landfills are required to take corrective actions, per RCW 70A.540.050(2), as well as rules adopted by Ecology.

The consequence of not adopting rules on the requirements outlined in the first paragraph is that the statutory methane concentration limits listed above would be exceeded and no corrective actions would be taken. Because of this, there are no alternatives to this required rulemaking.

Please see the Least Burdensome Alternative Analysis, Chapter 6 of this document, for discussion of alternative rule content considered.

C. RCW 34.05.328(1)(c) - A preliminary cost-benefit analysis was made available.

When filing a rule proposal (CR-102) under RCW 34.05.320, Ecology provides notice that a preliminary cost-benefit analysis is available. At adoption (CR-103 filing) under RCW 34.05.360, Ecology provides notice of the availability of the final cost-benefit analysis.

D. RCW 34.05.328(1)(d) – Determine that probable benefits of this rule are greater than its probable costs, taking into account both the qualitative and quantitative benefits and costs and the specific directives of the statute being implemented.

See Chapters 1 – 5.

E. RCW 34.05.328 (1)(e) - Determine, after considering alternative versions of the analysis required under RCW 34.05.328 (b), (c) and (d) that the rule being adopted is the least burdensome alternative for those required to comply with it that will achieve the general goals and specific objectives stated in Chapter 6.

Please see Chapter 6.

F. RCW 34.05.328(1)(f) - Determine that the rule does not require those to whom it applies to take an action that violates requirements of another federal or state law.

This rule would not require covered parties to violate existing federal and state laws and rules. There are existing EPA requirements for MSW landfills, and some of the MSW landfills that may be impacted by this rule already comply with these federal requirements. This rule will implement more protective standards for decreasing methane emissions from these already impacted MSW landfills, as well as other MSW landfills that do not need to comply with current federal laws. Ecology is harmonizing requirements with these other existing federal laws wherever feasible.

G. RCW 34.05.328 (1)(g) - Determine that the rule does not impose more stringent performance requirements on private entities than on public entities unless required to do so by federal or state law.

The requirements of this rule apply to all active and closed MSW landfills that have received solid waste after January 1st, 1992, regardless of whether the owner or operators of these landfills are public or private entities.

H. RCW 34.05.328 (1)(h) Determine if the rule differs from any federal regulation or statute applicable to the same activity or subject matter.

Yes.

If **yes**, the difference is justified because of the following:

(i) A state statute explicitly allows Ecology to differ from federal standards. Chapter 70A.540 RCW

(ii) Substantial evidence that the difference is necessary to achieve the general goals and specific objectives stated in Chapter 6.

· RCW 70A.540.030 – threshold for active MSW landfills is 450,000 tons of waste in place, and closed MSW landfills is 750,000 tons of waste in place. Federal requirements (NSPS) are a much higher threshold of 2.5 million metric tons of waste in place.

· RCW 70A.540.030 – threshold for methane generation is 3,000,000 British thermal units per hour recovered, whereas the NSPS standard is in megagrams (34 megagrams) for non-methane organic compounds (NMOCs)

· RCW 70A.540.040 – MSW landfills that can demonstrate they have less than 200 ppmv of surface methane do not need to install a gas collection and control system. The NSPS standard is 500 ppmv, a higher threshold.

· RCW 70A.540.040 – methane destruction efficiency is 99% for flares, whereas NSPS standard is 98% for NMOCs.

I. RCW 34.05.328 (1)(i) – Coordinate the rule, to the maximum extent practicable, with other federal, state, and local laws applicable to the same subject matter.

To harmonize the rule with other landfill methane laws, Ecology has been consulting with the US EPA, California Air Resources Board, and Oregon Environmental Quality Commission. Per RCW 70A.540.020(3), the rules adopted by Ecology must be informed by landfill methane regulations adopted by the above agencies.