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October 3, 2019

Via Email and FedEx
Charles.gruenenfelder@ecy.wa.gov

Mr. Charles Gruenenfelder, L.G., L.Hg.
Toxics Cleanup Program
WA State Department of Ecology
4601 N. Monroe St.
Spokane, WA 99205-1265

Re: Basin Disposal, Inc. and Pasco Sanitary Landfill, Inc.'s Comments on Draft Consent Decree, Pasco Landfill NPL Site

Dear Mr. Gruenenfelder:

On behalf of Basin Disposal, Inc., ("Basin") and Pasco Sanitary Landfill Inc., ("PSLI") we provide what follows as Basin and PSLI's comments upon the draft Consent Decree and the accompanying dCAP (draft Cleanup Action Plan) and SOW (Scope of Work) with regard to the Pasco Sanitary Landfill ("PSL").

BACKGROUND FACTS

As you know Basin and PSLI were declared PLPs in 1992 and have, since that time, been actively engaged in the process of investigating and remediating the site. Our focus has been upon the Municipal Solid Waste (MSW) portion of the PSL site since neither Basin nor PSLI had any involvement with the industrial waste section of the site, now denominated Zone A, and PSLI's only involvement was as the property owner long after industrial waste disposal ceased.

You are aware that beginning in 2002 Basin, PSLI and other members of the "Landfill Group" became very active in implementing interim remedial actions at the MSW. These actions included installation of an extensive gas extraction well network, for capture and incineration of methane emissions from the waste mass as well as for monitoring purposes. At the same time a 40mil hard plastic cover was installed across the entire breadth of the former landfill, a nearly 40

acre expanse. *See Exhibit 1.* We believe you are aware that the cover, alone, costs millions to purchase and install. After installation the cover was overlaid with 18-24 inches of soil which then facilitated vegetative growth atop the overlay.

As you are also aware, the Solid Waste industry recognized early on that the performance of geomembranes in cover systems depended in large part on the quality of the geomembrane installed. As a result, the Geosynthetic Institute was created to establish consistent criteria for manufacturers of geomembranes so that manufacturers could supply reliable product for long-term engineering controls. Extensive service life data currently available to the industry and to Ecology establishes that the service life for commercially available geomembranes is measured in terms of at least several hundred years (Hsuan and Koerner, 1998; Hsuan and Koerner, 2002). The geomembrane cover of the MSW portion of the PSL site is no exception.

At the time the cover was installed, pursuant to industry standards, over 200 test sites were drilled in the cover and samples were examined in a laboratory to assure that the hard plastic had been manufactured properly in order for the geomembrane cover to achieve its more than 100 year useful life. The cover was found to be constructed and installed exactly as specified. *See Exhibit 2*. The referenced more than 100 year useful life of the cover, of course, is multiples of the time over which we expect it to take for the MSW to be sufficiently decomposed to achieve functional stability.

Year after year these interim remediation measures at the MSW have produced continuous improvement in the condition of the underlying groundwater. These measures have also assured that fugitive methane emissions have ceased. And these results have been obtained with minimal disruptions, and without complications, as verified by the quarterly and annual testing and reporting results provided to Ecology.

These interim actions—a sometimes proxy for vetting what may work as a final remedy—proved their worth. Consequently, Basin, PSLI and BNSF engaged Aspect Consulting to provide Ecology with a variety of remedial alternatives—including a continuation of the interim remedy apparatus and process, during the first of two Focused Feasibility Studies. One FFS was advanced in August, 2014, and another in August, 2017.

FINDINGS SUPPORTING FFS PROCESS: 2014 and 2017

Long discussion of the FFS process is not warranted since very little of note occurred during preparation of either the 2014 or the 2017, FFS. Basin and PSLI essentially recommended continuation of the interim remedies given their excellent performance. In doing so, Basin and PSLI value tested our recommended remedy by performing disproportionate cost analysis, affirming that not only was the ongoing remediation likely to be successful, but it could be accomplished at reasonable cost. Given the performance of the cover atop the MSW, its construction, testing results, and absence of any reason to expect it to fail during the likely remediation period (or, for that matter, for 50 years beyond that), Aspect/Basin/PSLI recommended a remedy which left the cover in place, and urged that the existing remediation apparatus continue in place as well.

When making these recommendations during the respective FFS processes, Basin and PSLI were armed with compelling laboratory and field data which fully supported the recommended alternative. So that any audience can judge for itself the efficacy of our measures, and the performance verified by testing, we discuss below some of the evidence supportive of the position taken here.

Total Historical Absence of Fugitive Methane Emissions/Exhibit 3

One principal purpose of installing a geomembrane cover over the MSW is to assure that the well suction/capture system is able to extract the methane which emits from the waste pile as it shrinks due to active microbial processes. Harm from methane is well understood, and any cover's performance can be judged, in part, by whether testing for fugitive methane emissions shows the presence of any such emission.

Exhibit 3 is a depiction of the track technicians walked with methane testing gear, every three months, throughout the past 17 years. As the table illustrates, at no time has fugitive methane emissions testing detected *any methane emissions* outside the cap. This demonstrates virtually perfect performance of the cap using that criterion of performance.

Dramatic Decrease in Methane Production/Exhibit 4

The scientific lore of landfills has long established that a waste pile generates methane during decomposition. Observing declining production of methane over time demonstrates the diminishing capacity of the waste pile to continue producing methane. Progress in this critical measurement helps demonstrate that the remediation measures in place at the MSW are effective.

That has been exactly the history of observation of methane production at the PSL since 2002. Exhibit 4 shows the decline of methane production over time from 66 cubic feet per minute in 2003 to 19 cubic feet per minute in 2018. The slope of the graph tracking methane shows methane production has consistently gone down and is now moving toward *de minimis* production levels.

At present the remaining methane produced by the waste pile will fuel the existing flare at the MSW but that will not remain the case much longer. By approximately 2022 our consultants have opined that too little methane will be produced to fuel the present flare any longer so, either a very small flare will replace the present flare, or levels will be low enough to allow exhaust to the atmosphere, or some form of bio-filter will be used to capture the remaining methane production.

These trends are, of course, more proof of the high utility of the interim remedies in place since 2002.

Chemicals of Concern (COC) Nearing and Meeting Cleanup Levels/Exhibits 5 and 6

The primary health hazard posed by the MSW stems from its production of methane, since the waste contains very little industrial or toxic waste. That said, two COCs were identified during testing of the MSW, which is quite unlike the situation at Zone A: PCE and TCE.

In the 17 years the interim remediation system has been operating, TCE levels have dropped below cleanup levels. This impressive result is borne out in the graphs shown in Exhibit 5, which track the downward trajectory of TCE over a long period, measured at five different wells. We are very pleased with these results which substantiate Basin and PSLI's long held view that the meager amounts of TCE present would be remediated during the interim remedy period.

Excellent progress has been made in remediating the small amounts of PCE present at the MSW as well, though PCE remains at slightly above cleanup levels in a single well, presently. If, as expected, PCE levels continue to drop consistent with their long-term declining trajectory, Basin and PSLI expect PCE levels to drop below cleanup thresholds in the next few years. These trends are depicted, across five different wells in the MSW, in Exhibit 6.

Pristine MSW Cover Condition: Absence of Indents or Depressions/Exhibits 7 and 8

In addition to the foregoing—all of which helps demonstrate the high performance of the MSW cap—it is evident the cover is in virtually the same condition it was in immediately following installation in 2002. Settlement has never been observed during any of the annual inspections of the MSW Landfill Cover carried out by our consultant. *See Exhibit 7.* This is in obvious contrast to the cover over Zone A, where deep indents (some as deep as 6-8 feet and holding water,) have raised concern that the Zone A cover cannot 'stretch' to respond when underground settlement causes the land beneath the cover to sink (the Zone A indents are probably, but not certainly, a response to the below ground drums collapsing over time, thereby occupying less space and allowing the land above to settle lower).

The topography of the land above the MSW remains virtually identical to its topography when the cover was installed. As the photos from 2010, and 2019 (attached in Exhibit 8) show, there are no areas of differential settlement in the MSW. Given that differential settlement can, when extreme, damage or compromise the cover, its absence supports the opposite inference: the cover is experiencing no strain since there is no observable differential settlement after 17 years of cap service.

According to our consultants, the odds of any differential settlement occurring in the future are lower than the odds of it appearing in the past because the mass of the waste pile shrinks over time. When, as here, the shrinking waste pile has never caused any differential settlement, it is highly unlikely that any significant differential settlement will occur between now and the time when the MSW achieves functional stability.

Solid Compounds Discussion/Exhibit 9

Groundwater conditions downgradient of the landfill have been within the natural variability of the aquifer. The maximum background concentrations for total dissolved solids (salts), total organic carbon (non-toxic decomposition byproducts), and ammonia reflect land use upgradient. If groundwater downgradient had higher concentrations than the maximum background concentrations, or increasing trends, it would indicate a potential source of leachate from the landfill. Thus, there have been no leachate impacts from the MSW landfill historically. The risk of leachate production in the future is lower than in the past due to aging waste and excellent cover system performance keeping water out of the waste, yet another consistent marker of the efficacy of the present cover. We expect no future leachate impacts from the MSW landfill.

These results are shown in the collection of figures at Exhibit 9.

No Landfill in Washington With Groundwater Issues Has Ever Replaced a Cover Post-Installation/ Exhibit 10

As discussed above, the 40mil hard plastic cover atop the MSW has proven to be an excellent and well-functioning component of the overall apparatus which is being used to remediate the MSW. Since good guidance, and EPA guidelines, recommend assessing cover performance by examining the very features discussed above, it is a safe conclusion that the present cover on the MSW is performing very well. It would be hard to imagine any way it could be performing better than it is.

Geomembrane landfill covers are extremely expensive (presently, they cost on the order of $250,000/acre—and this landfill cover extends over just less than 40 acres). They are manufactured to exacting standards. Some, including the one installed at the MSW have a useful life of more than 100 years, and its installation was meticulously performed to assure that that longevity standard can be met (Exhibit 2). From every available indicator, it appears that this landfill cover is already more than half way through the period it will require to achieve functional stability at the MSW (when leachate and gas production have stopped or slowed to the point that human health and the environment are protected). It is performing perfectly.

Similar covers are installed at multiple landfills in Washington State where groundwater issues have been encountered, and remediation efforts have required installation of geomembrane covers. Installation of those covers, and review of the operations at those landfills (as well as review of their going forward budgets for continuing remediation efforts) establish that *no similar landfill in the history of the State of Washington* has ever required replacement of the cover over the landfill. That is in part attributable to the high manufacturing standards met by the geomembrane cover manufacturers, and is also an artifact of the absence of high levels of heat, UV exposure, or exposure to high toxic chemical levels, in the ordinary municipal sanitary waste landfill, as is the case here.

Nothing in this experience, in the literature, or in the performance to date of the cover at the PSL suggests that the cover will *ever* require replacement during active remediation, or during monitoring of the landfill after active remediation operations cease in 10-15 years at the MSW.

Basin and PSLI's position is that no engineering or scientific source, anywhere, suggests that the PSL's 40mil hard plastic cover will ever require replacement. Indeed, the present cover has never required even simple repairs over the past 17 years (occasionally the overlying earth cover has needed additional soil or turf repair, but that is attributable to wind and weather events which have no effect on a geomembrane cover).

To assure ourselves that the history in Washington is as stated, Basin and PSLI have inventoried the landfills on Ecology's confirmed and suspected contaminated sites list where groundwater issues were present, including those at which Ecology, local health departments and federal agencies were directing the remedial actions and at which geomembrane caps were installed in response to groundwater contamination. From the resources available through Ecology and the local government agencies involved in clean up and monitoring of these landfills, we have determined that none of the geomembrane covers at these landfills have ever needed to be replaced and further, that there has never been a requirement for future replacement of covers at any of the landfills inventoried. Those landfills are described in Exhibit 10.

As the reader can see, not one landfill ever has required replacement of the cover.

Competent Cost Benefit Analysis Eliminates Consideration of an MSW Cap Replacement/ Exhibit 11

The historical record shows that Basin and PSLI have worked vigorously, throughout the 1990s, and to the current time, to advance and fund remediation at the MSW. We are as interested as any citizen, or any other PLP, in successfully remediating the MSW. Basin and PSLI have invested heavily in the success of that undertaking and have agreed to be bound by multiple interim remedy orders issued by Ecology during that process.

Now we find ourselves trapped between that history, and the desire to continue it, and the recent conduct of Ecology, which appears to require that Basin and PSLI cannot become a party to the Consent Decree now under consideration. Our reason is simple: after five years of process, only at the very end of the resolution process did Ecology require, or consider requiring, a replacement of the cap atop the MSW. This was for good reason, as the foregoing illustrates: nothing, anywhere, supports the notion that the cap will ever require replacement during the relatively short period it will continue to serve.

Yet the threat from Ecology that a cap replacement might be ordered in the future has foreclosed Basin and PSLI from agreeing to be bound by the present content of the Consent Decree. We continue to hope Ecology will modify its position relating to cap replacement at the MSW which would then allow Basin and PSLI to reconsider our present opposition to signing.

What brought the parties to this impasse is instructive. Long before discussions begin between PLPs and Ecology concerning a Consent Decree, PLPs will commonly engage expert consultants and will prepare a Focused Feasibility Study ("FFS") which is a technical document prepared after much engineering effort and study. When compiled, an FFS will include 'remediation alternatives,' which, in short, are descriptions of various plans by which the area in

issue (here, the MSW; other parties were required to prepare an FFS about Zone A) can be remediated.

Integral to the process of delineating and settling upon a final 'remediation alternative' is application of a mandate that the cleanup alternatives be subjected to rigorous 'cost benefit analysis.' The jargon used in the applicable mandate, WAC 173-340-360(3)(e)(i), requires that the parties and Ecology conduct a 'disproportionate cost analysis.' This analysis is required under Washington law and serves to make parties, and Ecology, analyze any potential remedial alternative to assure that it is cost effective.

This process, on occasion, requires additional study, research, and any likely alternative may be subject to challenge on the basis of prohibitive cost, or questionable efficacy, or any combination of the two. For example, were Ecology to raise a concern about the need for a future expense based upon a belief that a part of the proposed remedial apparatus might fail, or require replacement, the disproportionate cost analysis process would support study of the likelihood of failure, and if the likelihood is very low, would also include assessment of the cost of replacement. In this way, hopefully, resources are not devoted to expenditures which do not advance remedial objectives which are frankly wasteful of PLP funds.

One critical element in this process is that it requires advance notice of any concerns Ecology might have about efficacy or cost since, otherwise, decision-making could be based upon ill-considered or non-evidence-based deliberation. That is precisely why the FFS process occurs long before any work begins on a Consent Decree since the Consent Decree itself incorporates Ecology's partial or whole adoption of remedial alternatives outlined during the FFS process. Given that the FFS process for the PSL began in 2013, and that Ecology first outlined Consent Decree SOW and dCAP language in March/April 2019, a long deliberative process is possible *if* Ecology raises concerns in a manner timely enough to allow rigorous disproportionate cost analysis.

Ecology makes many efforts to interface with PLPs during this process. Work sessions, comments from Ecology, and additional long periods for comment are provided by Ecology which allow it to review and advise the parties regarding whether any issues of concern to Ecology are raised by the content of the FFS.

At the PSL, largely due to issues concerning Zone A and combustion there, and not regarding concerns about the MSW, two different FFS submittals were provided by the PLPs, one in August, 2014, and one in August, 2017. In the run up to the deadline for both submittals, many communications between Ecology and our consultants occurred to assure that the FFS process was as robust and productive as it could be.

Certainly during those processes, any concerns of any kind regarding the integrity and future service of the cover over the MSW would be raised by Ecology, had there been any such concerns. Given the performance of the cover during the long interim remedy period, and further given the showing that the MSW was evidencing strong results from Basin and PSLI's remediation efforts, it is unsurprising that never at any time during the FFS process, and during the post FFS submittal time period, was anything ever said by Ecology regarding concern that the cover might

lack 'integrity' or that in the future the cap might need 'replacement.' Neither of those concepts was ever even discussed during the FFS and post FFS periods.

Had any such concerns been raised during those processes, there remained adequate time to allow study or research into any concerns Ecology might raise about any issue, including future cap integrity. For example, if Ecology feared that a manufactured geomembrane cap with a more than 100 year useful life might, somehow, require replacement in the future, means existed to test the existing cap's strength and performance. But such testing requires time, laboratory analysis, and notice that such concerns even existed. Never, prior to March, 2019, did Ecology suggest at any time that it had concerns about the cover over the MSW.

An additional reason why such concerns need be raised prior to these activities culminating in creation of the work directives in the Consent Decree, is that otherwise there would be no means to conduct disproportionate cost analysis of anything Ecology might call out as a potential future burden on a PLP. For example, if the likelihood of any future failure of the MSW cover were 1:10,000,000, and replacing the cover would cost $10 million (the reader should bear in mind that the entire cost of the MSW remediation, going forward, will be less than $2.5 million from the present to the time the MSW achieves functional stability), a forceful case could be made that contemplating future cover replacement was simply not indicated.

Throughout this process at the PSL, Ecology was mute on the issue of ever requiring cover replacement. This is neither surprising nor unwarranted: as shown, no other landfill *has ever* replaced a cover in place and the expected lifetime of the cover at the PSL is multiple times the expected years of service the cover will function at the PSL.

Basin and PSLI have examined the history which brought us to the present and were witness to Ecology's very recent expression that the Consent Decree SOW/dCAP should include language suggesting the MSW cover may need future replacement. As the timeline in Exhibit 11 makes clear, this mandate appeared from nowhere, and was never raised at any time earlier when the suggestion now made could have been scientifically vetted, the cover could have been tested, and any claim that the cap might need replacement in the future could have been disposed of definitively.

By raising the issue at the very end of this six year process, Ecology deprived Basin, PSLI, and others, from showing with impactful disproportionate cost analysis that such a command is simply, and completely, unjustified.

Exhibit 11 calls out these events in a timeline which showcases the points Basin and PSLI make, above.

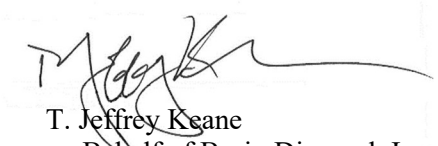
CONCLUSION

We trust anyone reading these comments has found them helpful, and informative. More importantly, we do hope Ecology will revisit the decision to include cover replacement/cover integrity testing language in the SOW/dCAP, will appreciate that no basis exists for the inclusion of same, and will remove such language.

Thank you for the opportunity to present these comments.

Very truly yours,

KEANE LAW OFFICES



T. Jeffrey Keane
on Behalf of Basin Disposal, Inc.

NOSSAMAN LLP

Leslie C. Nellermoe

Leslie C. Nellermoe
on Behalf of Pasco Sanitary Landfill, Inc.

enclosures

cc: Darrick Dietrich

EXHIBIT 1

Deployment of 40 mil textured LLDPE geomembrane north slope MSW area.

Deployment of 40 mil textured LLDPE geomembrane on west slope MSW area.

Field Lining Systems sewing geotextile.

Vegetative soil layer placement on north slope of MSW area.

EXHIBIT 2

PAGES FROM:

COMPLETION REPORT

PASCO LANDFILL INTERIM ACTION
MSW LANDFILL & IWA ZONES A C/D and E

APPENDIX A

CONSTRUCTION QUALITY ASSURANCE REPORT

VOLUME I OF II

Prepared for:

Philip Services Corporation, Inc.
955 Powell Ave SW
Renton, Washington 98055

Prepared by:

GeoSyntec Consultants
11305 Rancho Bernardo Road, Suite 101
San Diego, California 92127

21 June 2002

7. CQA – GEOMEMBRANE

7.1 General

GeoSyntec monitored installation of the geomembrane components of the PAIA cover systems. Approximately 1,884,045 ft^2 of textured and approximately 177,422 ft^2 of smooth 40-mil LLDPE geomembrane, manufactured by Serrot International, Inc., were delivered to the site for use as the geomembrane component of the cover system in the MSW area. Approximately 181,240 ft^2 of textured and approximately 35,880 ft^2 of smooth 40-mil HDPE geomembrane, also manufactured by Serrot International, Inc., were delivered to the site for use as the geomembrane component of the cover systems in the IWAs. Smooth geomembrane was used as the base liner for the detention/evaporation basin component of the surface water control system. Table 3 summarizes the required testing frequencies, acceptance criteria, and results for the CQA monitoring activities.

Construction of the geomembrane components of the cover system began on 7 October 2001 and was substantially completed on 19 December 2001.

7.2 Manufacturer Documentation

The Contractor provided manufacturer quality control (MQC) documentation for the rolls of geomembrane. GeoSyntec reviewed the geomembrane MQC documentation and found it to be in compliance with the Project Documents as noted in Table 3. The documentation indicated that the geomembrane and resin properties met or exceeded the requirements specified in the Project Documents. As approved by the Design Engineer of Record, one (1) roll of textured HDPE geomembrane did not meet the asperity height requirements and, instead, was used on areas with slopes less than 10%.

7.3 CQA Monitoring and Testing

7.3.1 Geomembrane Conformance Testing

GeoSyntec personnel collected and shipped samples to the laboratory for conformance testing in order to determine the following properties of the geomembrane:

- Asperity height, as determined by test method GRI-GM12
- Density, as determined by test method ASTM D 1505;
- Carbon black content, as determined by test method ASTM D 4218;
- Carbon black dispersion, as determined by test method ASTM D 5596;
- Thickness, as determined by test method ASTM D 5994; and
- Tensile properties, as determined by test method ASTM D 638.

GeoSyntec personnel evaluated the following test results:

- 23 asperity height tests on textured geomembrane. This corresponds to a frequency of one test per 89,795 ft^2, which satisfies the required frequency of one test per 100,000 ft^2;

- 26 density tests. This corresponds to a frequency of one test per 87,638 ft^2, which satisfies the required frequency of one test per 100,000 ft^2;

- 26 carbon black content tests. This corresponds to a frequency of one test per 87,638 ft^2, which satisfies the required frequency of one test per 100,000 ft^2;

- 26 carbon black dispersion tests. This corresponds to a frequency of one test per 87,638 ft^2, which satisfies the required frequency of one test per 100,000 ft^2;

- 26 thickness tests. This corresponds to a frequency of one test per 87,638 ft^2, which satisfies the required frequency of one test per 100,000 ft^2; and

- 26 tensile properties tests. This corresponds to a frequency of one test per 87,638 ft^2, which satisfies the required frequency of one test per 100,000 ft^2.

GeoSyntec personnel reviewed the results of the density, carbon black content, carbon black dispersion, thickness, and tensile properties and verified that the geomembrane material test results satisfied the requirements of the Project Documents. Results of the tests are summarized on test logs presented in Appendix J.

7.3.2 Delivery and On-Site Storage

GeoSyntec observed the delivery, unloading, and storage of the geomembrane rolls. The geomembrane rolls were handled and stored in such a way as to reduce exposure to sources of damage. Upon receipt at the site, the roll number identifications were recorded and compared with the MQC documentation.

7.3.3 Subgrade Preparation

GeoSyntec monitored the GCL or geomembrane subgrade surface prior to geomembrane deployment. GeoSyntec CQA personnel observed that the GCL and subgrade surface met the Project Documents. Subgrade acceptance was indicated by IT.

7.3.4 Geomembrane Placement Methods

GeoSyntec visually observed the deployment of the panels of geomembrane. The Geosynthetic Installer transported the rolls using a spreader bar and front-end loader in a manner intended to reduce damage to the geomembrane. During and after deployment, geomembrane panels or rolls were visually observed for the following:

- Evidence of damage that may have occurred during shipping, storage, and/or handling; and

- Evidence of damage caused by the installation activities, (e.g., as a consequence of panel placement, seaming operations, or weather).

Damaged materials were either removed and discarded or repaired. GeoSyntec monitored repair locations and observed that the repair activities were performed properly. Whenever possible, the cause(s) of the damage was ascertained and addressed. The Geosynthetic Installer then acted to minimize the potential for further damage.

Panels were deployed by securing the roll to a spreader bar, manually placing the panel into position, and then securing the end of the geomembrane with sandbags. Approximately 93,170 ft^2 of textured 40-mil HDPE and approximately 9,070 ft^2 of smooth 40-mil HDPE geomembrane was deployed in IWA A; approximately 52,650 ft^2 of textured 40-mil HDPE geomembrane and approximately 12,712 ft^2 of smooth 40-mil HDPE geomembrane was deployed in IWA E; approximately 27,315 ft^2 of textured 40-mil HDPE geomembrane and approximately 8,100 ft^2 of smooth 40-mil HDPE geomembrane was deployed in IWA C\D; and approximately 1,734,201.5 ft^2 of textured 40-mil LLDPE geomembrane and 145,030 ft^2 of smooth 40-mil LLDPE geomembrane was deployed in the MSW area. Roll # 22281 of smooth LLDPE geomembrane was used in the construction of the storm water runoff flaps on the MSW. Rolls # 26462, # 26464, and # 26466 of textured LLDPE geomembrane were not used and subsequently removed from the site by the Geosynthetic Installer. GeoSyntec personnel recorded details of the panel placement on the geomembrane Panel Placement Logs, which are presented in Appendix K. The orientations of geomembrane panels placed during cover system construction are shown on the Construction Record Drawings presented in Figures 1 and 2.

9. SUMMARY AND CONCLUSIONS

Construction of the PAIA occurred during the period of 6 September 2001 to 23 December 2001. During this time, GeoSyntec provided qualified CQA personnel on-site to monitor and observe construction. As part of their CQA activities, GeoSyntec personnel monitored the construction and installation of the following features:

- Earthwork, including excavation, engineered fill, geomembrane subgrade preparation, drainage layer placement, and a majority of the vegetative layer placement;
- Landfill gas extraction wells and piping;
- Geotextile/Geogrid reinforcement;
- Geosynthetic clay liner (GCL);
- Geomembrane; and
- Geotextile.

During construction activities, GeoSyntec CQA personnel performed conformance testing and CQA testing on the construction materials identified in this report at the frequencies outlined in the Project Documents. GeoSyntec CQA personnel monitored that the materials tested during construction conformed to the requirements of the Project Documents. Tables 1 through 4 summarize the required testing frequencies, acceptance criteria, and test results. In the event of non-conforming work, the condition or material that was identified as non-conforming to the requirements of the Project Documents was corrected, repaired, and retested (as described in this report), or discarded and not used.

10. CERTIFICATION

CQA ENGINEER - OF - RECORD

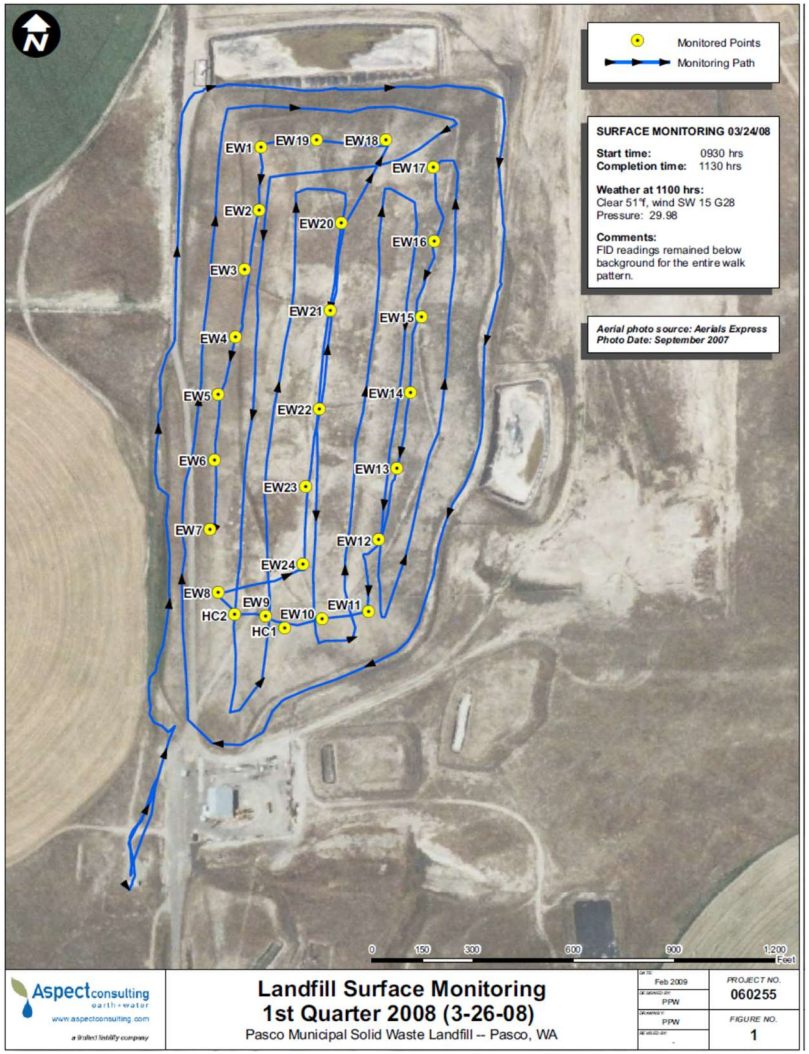
Based on the observations made on site during construction by GeoSyntec personnel working under the direction and supervision of the CQA Engineer-of-Record as described in this Final CQA Report and based on the logs and test results presented in the appendices to this report, the construction of the engineered fill, geomembrane subgrade, drainage layer, the majority of the vegetative layer, landfill gas extraction wells and piping (not including the well head and flare equipment), geosynthetic reinforcement, GCL, geomembrane, and geotextile portions of the cover system at the Pasco Landfill were constructed in general accordance with the Project Documents.

Edward Kavazanjian, Jr.
Registered Professional Engineer (Civil)
Certificate No. 34612

EXHIBIT 3

Landfill Surface Monitoring has been performed quarterly from 2007 through the present.
Fugitive methane has never been detected at any monitored points during this entire period.

Early Example of Landfill Surface Monitoring Map



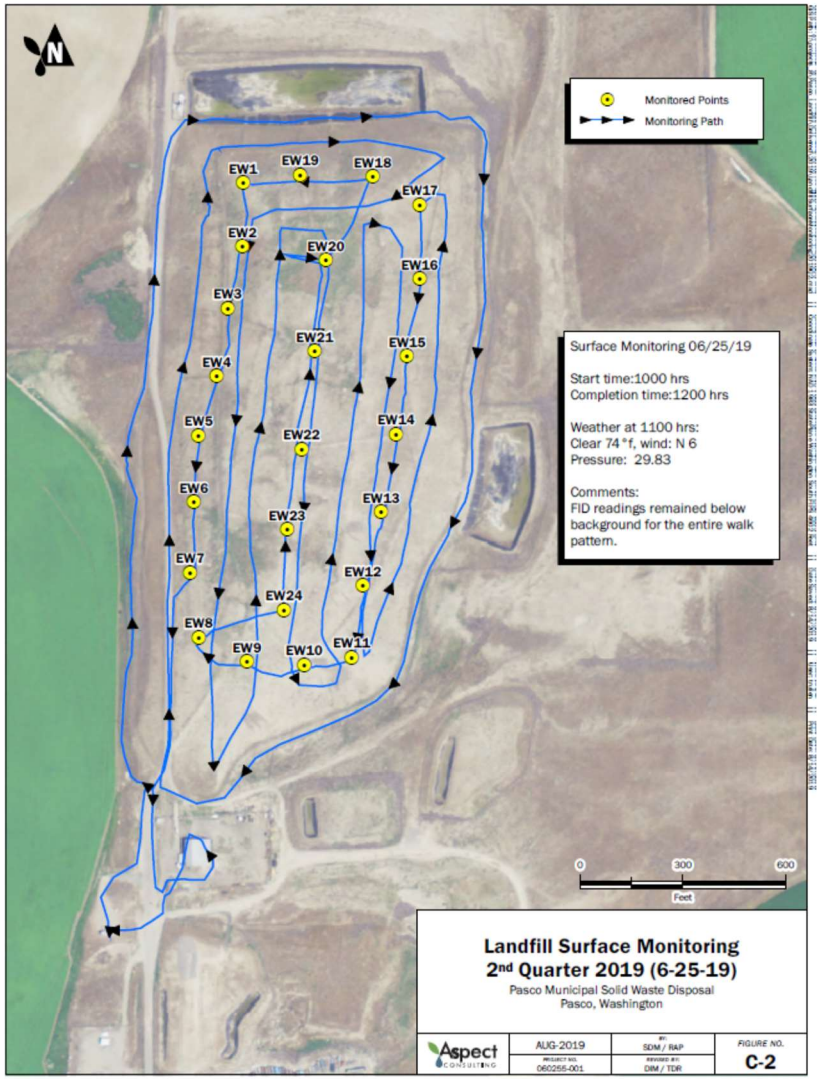
Dates of Quarterly Monitoring

Year	1st Q	2nd Q	3rd Q	4th Q
2007	03/11/07	06/12/07	09/21/07	12/21/07
2008	03/24/08	06/03/08	09/04/08	12/10/08
2009	03/09/09	06/02/09	09/17/09	12/02/09
2010	03/11/10	06/03/10	09/03/10	01/05/11
2011	03/17/11	06/23/11	09/15/11	12/09/11
2012	03/23/12	06/26/12	09/12/12	12/07/12
2013	03/08/13	06/14/13	09/26/13	12/17/13
2014	03/12/14	06/23/14	09/16/14	12/11/14
2015	03/12/15	06/03/15	09/17/15	12/01/15
2016	03/01/16	06/29/16	09/27/16	12/16/16
2017	03/30/17	06/01/17	09/08/17	12/05/17
2018	03/07/18	06/20/18	09/19/18	12/17/18
2019	03/26/19	06/25/19		

FID (Flame Ionization Detector) readings remained below background for the entire walk pattern for all of the above dates.

Landfill Surface Monitoring has been performed quarterly from 2007 through the present.
Fugitive methane has never been detected at any monitored points during this entire period.

Recent Example of Landfill Surface Monitoring Map

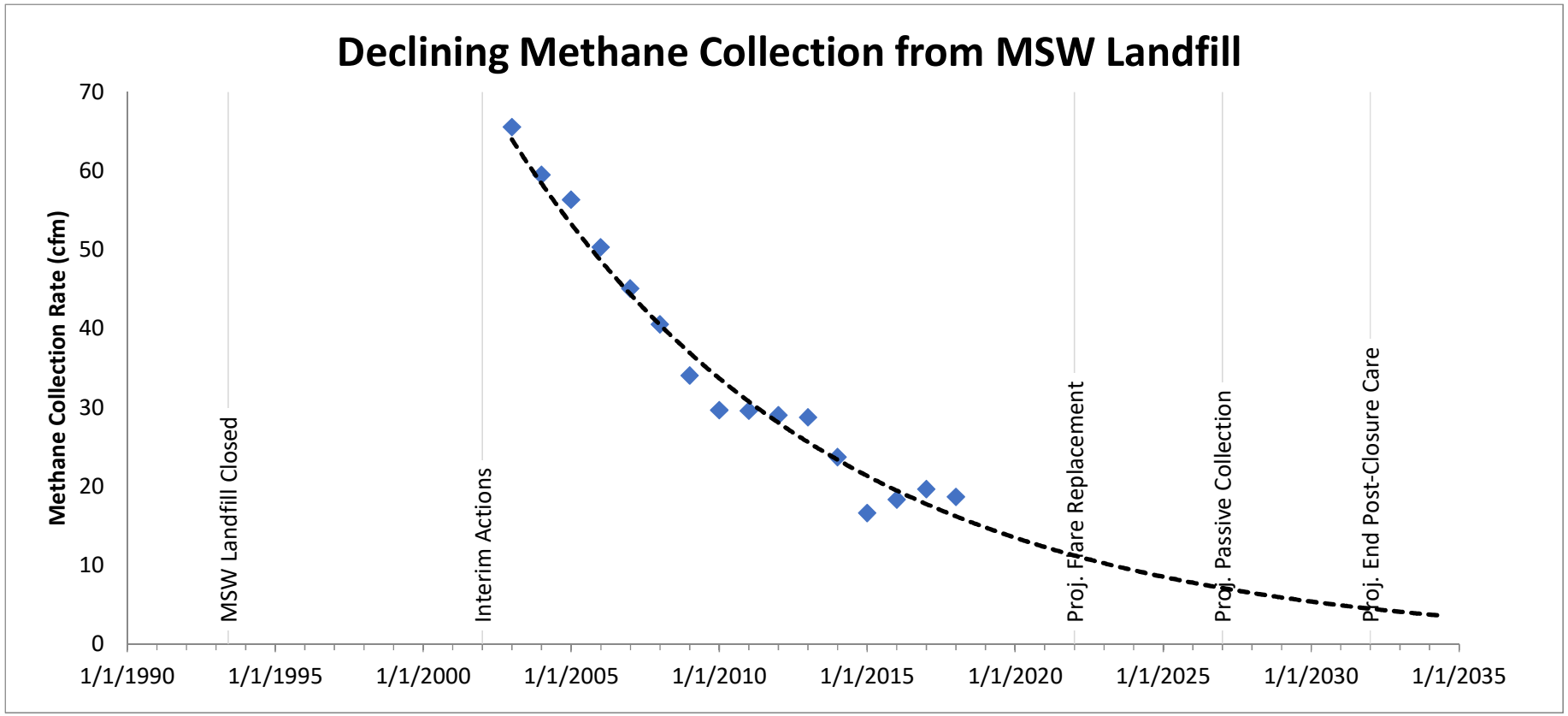


Dates of Quarterly Monitoring

Year	1st Q	2nd Q	3rd Q	4th Q
2007	03/11/07	06/12/07	09/21/07	12/21/07
2008	03/24/08	06/03/08	09/04/08	12/10/08
2009	03/09/09	06/02/09	09/17/09	12/02/09
2010	03/11/10	06/03/10	09/03/10	01/05/11
2011	03/17/11	06/23/11	09/15/11	12/09/11
2012	03/23/12	06/26/12	09/12/12	12/07/12
2013	03/08/13	06/14/13	09/26/13	12/17/13
2014	03/12/14	06/23/14	09/16/14	12/11/14
2015	03/12/15	06/03/15	09/17/15	12/01/15
2016	03/01/16	06/29/16	09/27/16	12/16/16
2017	03/30/17	06/01/17	09/08/17	12/05/17
2018	03/07/18	06/20/18	09/19/18	12/17/18
2019	03/26/19	06/25/19		

FID (Flame Ionization Detector) readings remained below background for the entire walk pattern for all of the above dates.

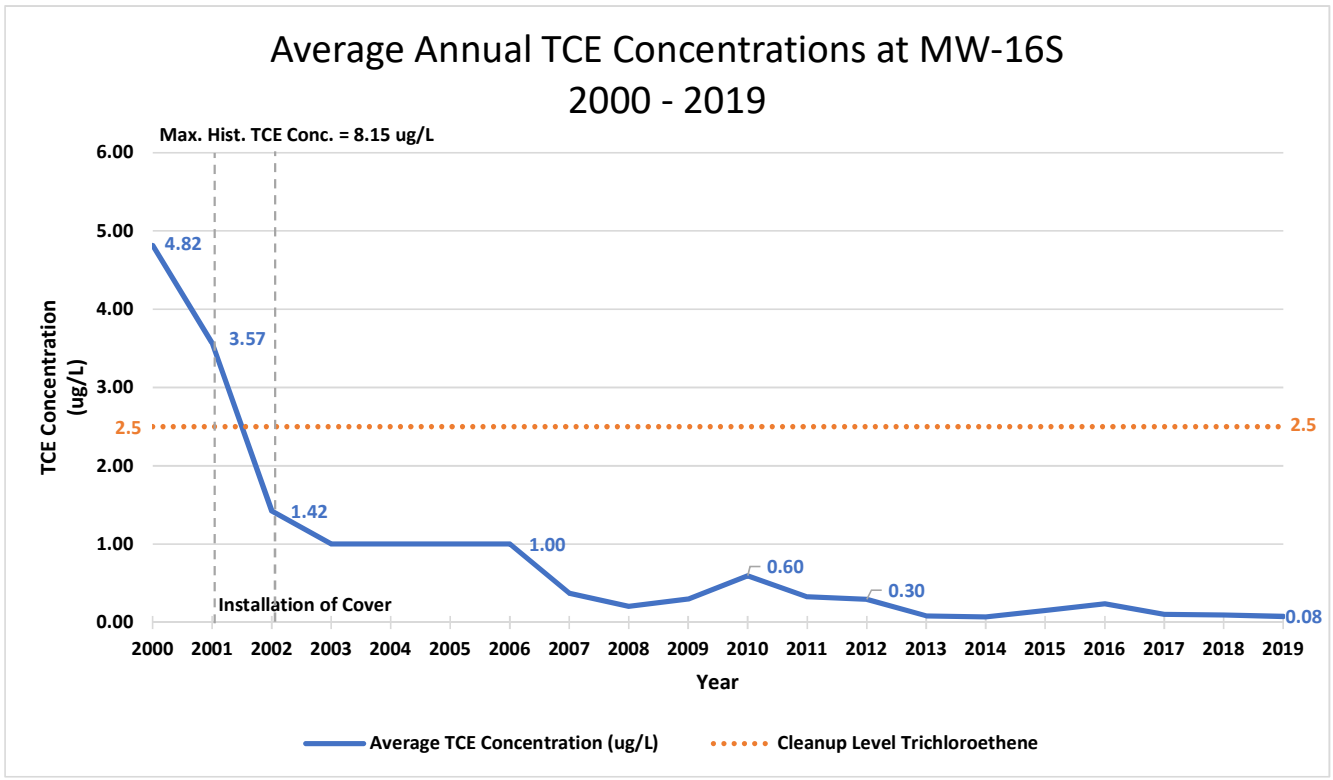
EXHIBIT 4

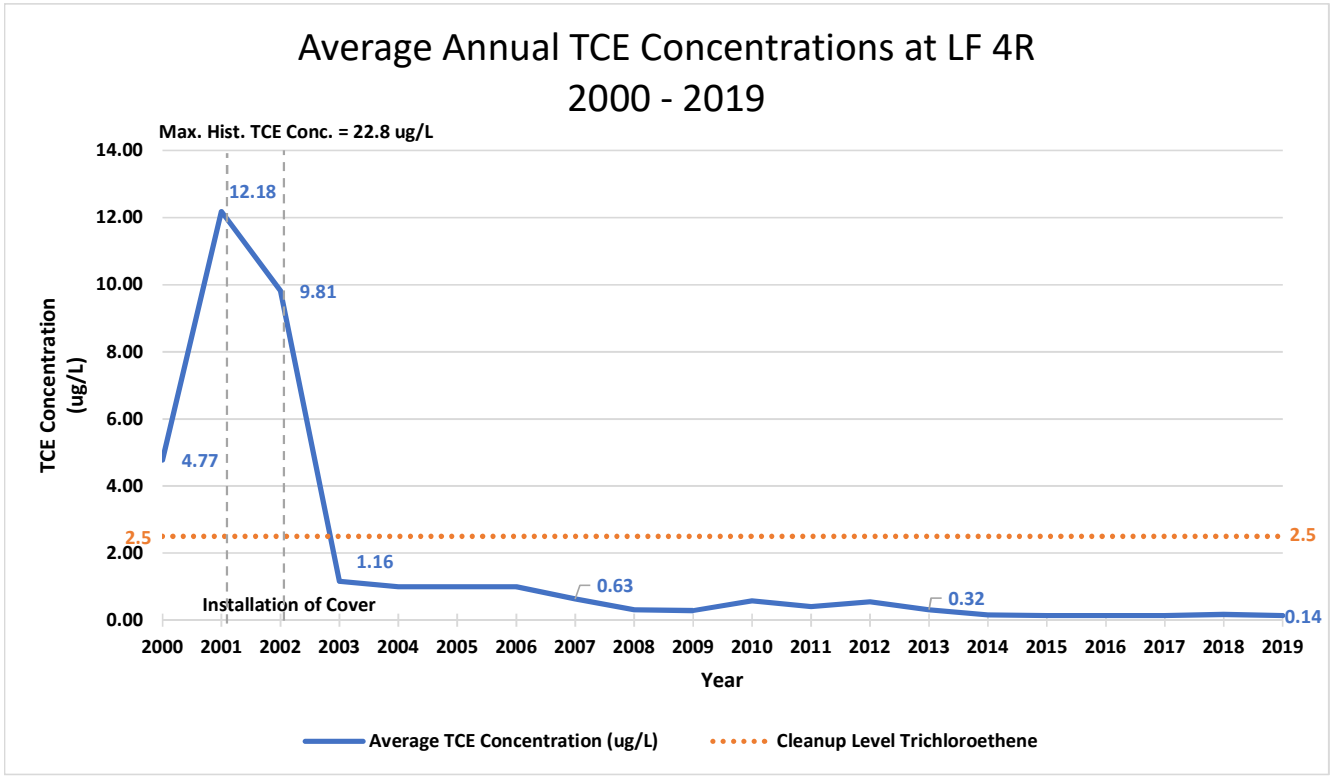


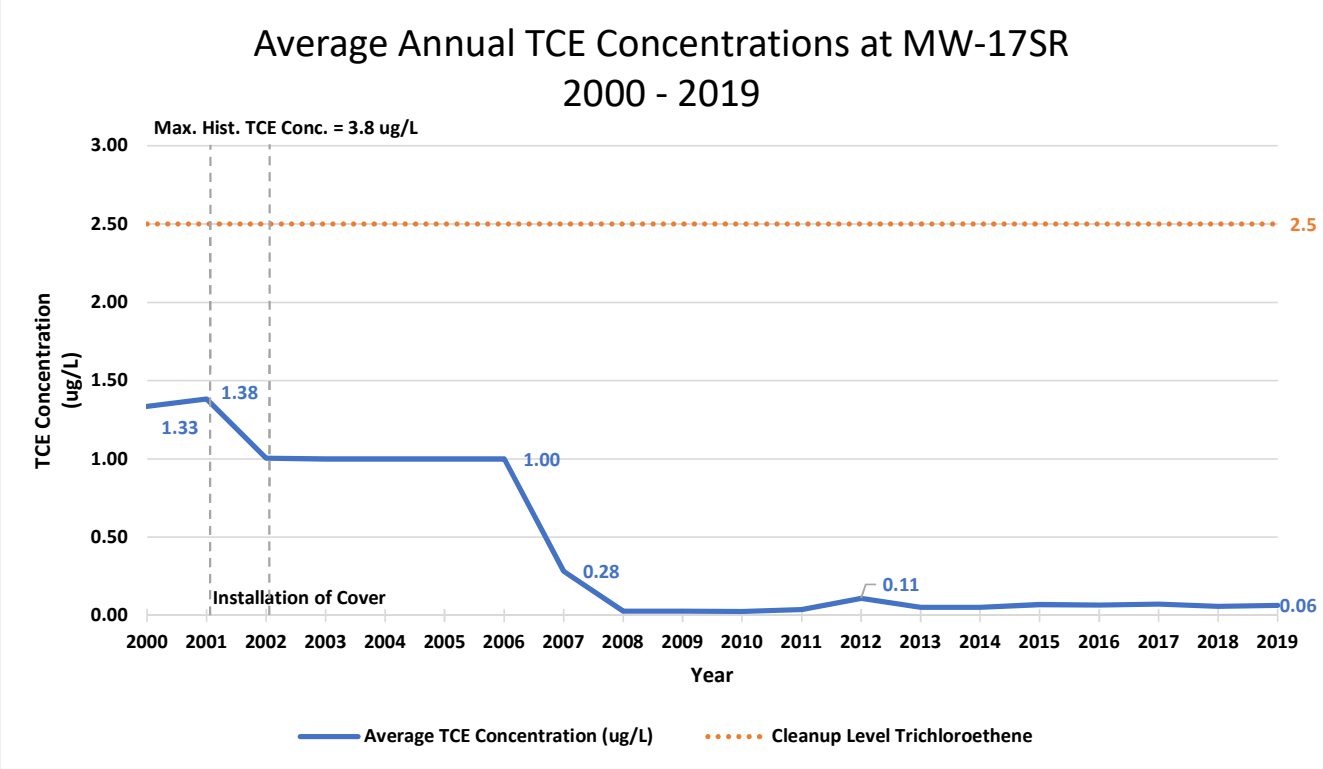
Aspect Consulting, LLC
09/20/19

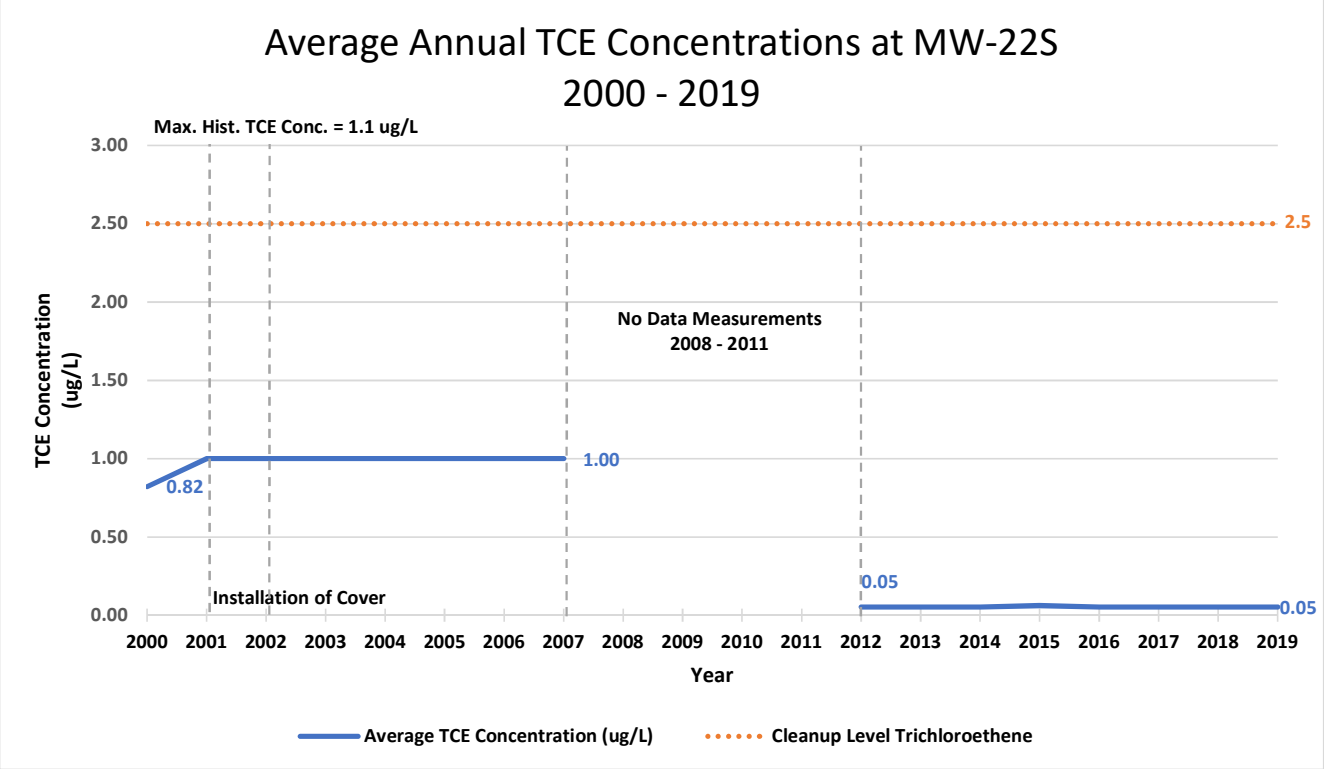
Methane Generation and Collection Rates
Pasco Municipal Solid Waste Landfill

EXHIBIT 5


Average Annual TCE Concentrations at MW-16S
2000 - 2019
Max. Hist. TCE Conc. = 8.15 ug/L
TCE Concentration (ug/L)
6.00
5.00
4.00
3.00
2.5
2.00
1.00
0.00
4.82
3.57
1.42
1.00
0.60
0.30
0.08
2.5
Installation of Cover
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Year
Average TCE Concentration (ug/L)
Cleanup Level Trichloroethene


Average Annual TCE Concentrations at LF 4R
2000 - 2019
Max. Hist. TCE Conc. = 22.8 ug/L
TCE Concentration (ug/L)
14.00
12.00
10.00
8.00
6.00
4.00
2.5
2.00
0.00
12.18
9.81
4.77
1.16
0.63
0.32
0.14
2.5
Installation of Cover
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Year
Average TCE Concentration (ug/L)
Cleanup Level Trichloroethene


Average Annual TCE Concentrations at MW-17SR
2000 - 2019
Max. Hist. TCE Conc. = 3.8 ug/L
TCE Concentration (ug/L)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
2.5
1.33
1.38
1.00
0.28
0.11
0.06
Installation of Cover
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Year
Average TCE Concentration (ug/L)
Cleanup Level Trichloroethene


Average Annual TCE Concentrations at MW-22S
2000 - 2019
Max. Hist. TCE Conc. = 1.1 ug/L
TCE Concentration (ug/L)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
2.5
No Data Measurements
2008 - 2011
0.82
1.00
0.05
0.05
Installation of Cover
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Year
Average TCE Concentration (ug/L)
Cleanup Level Trichloroethene

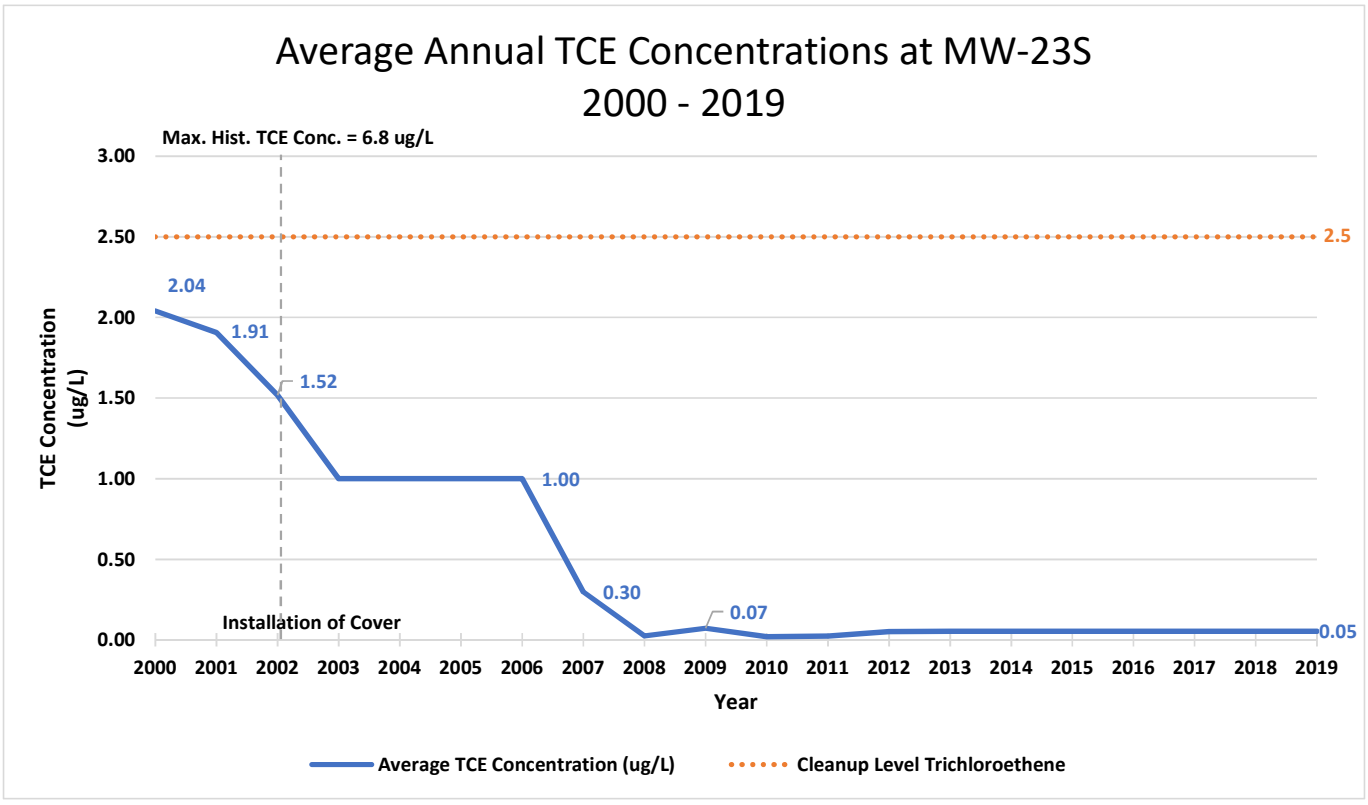
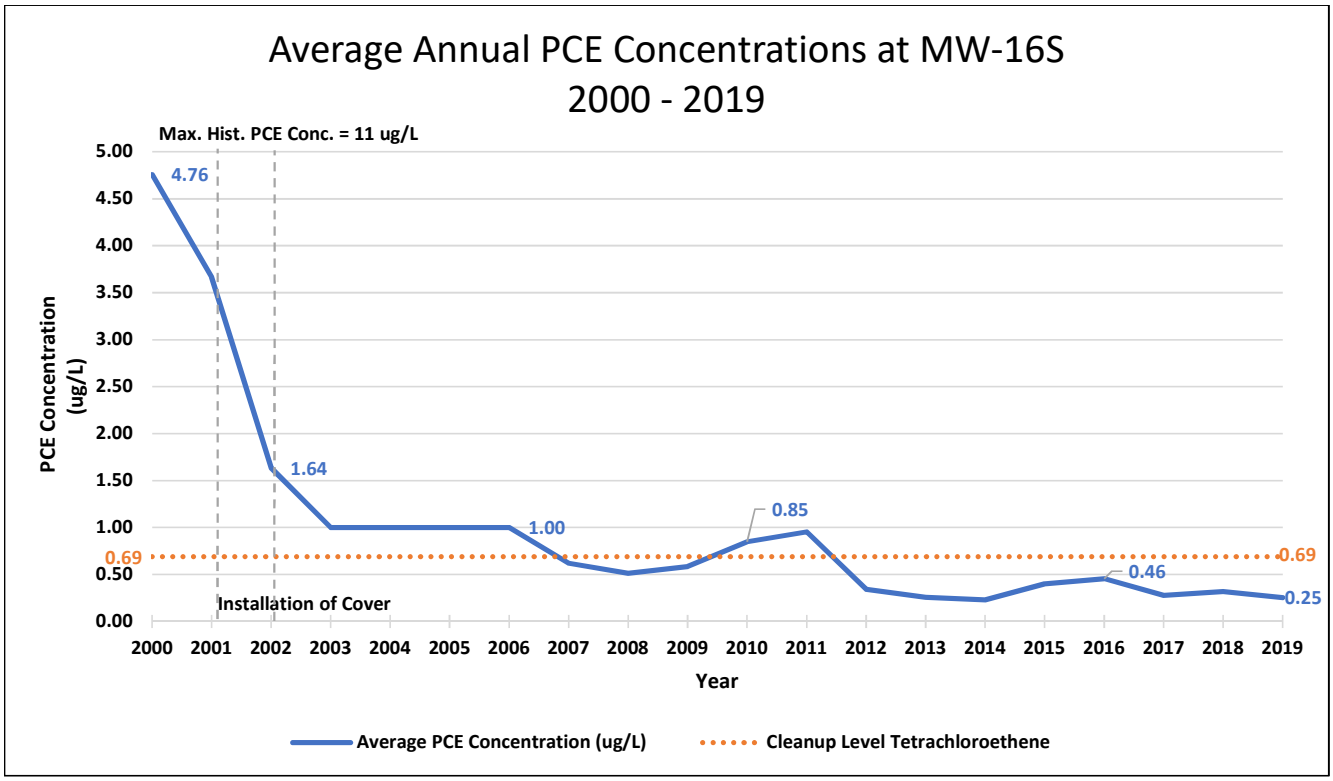
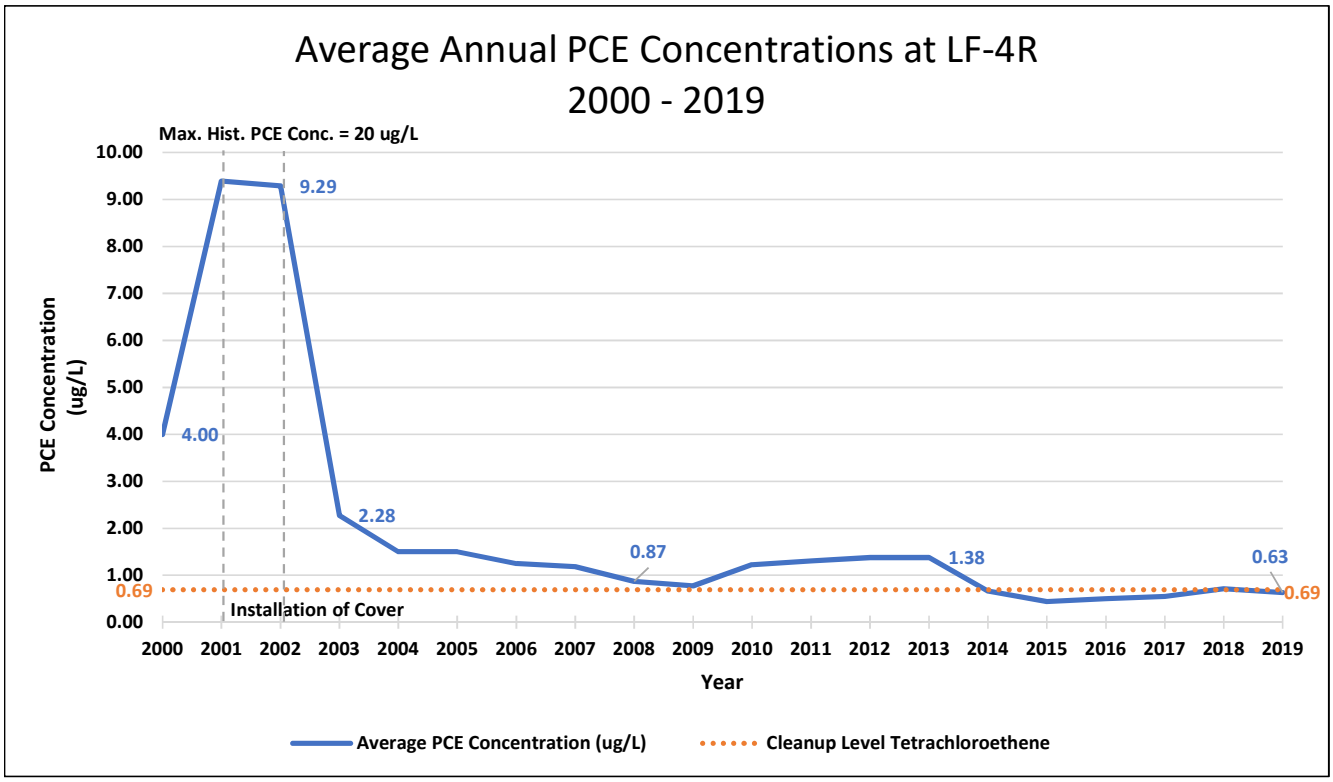
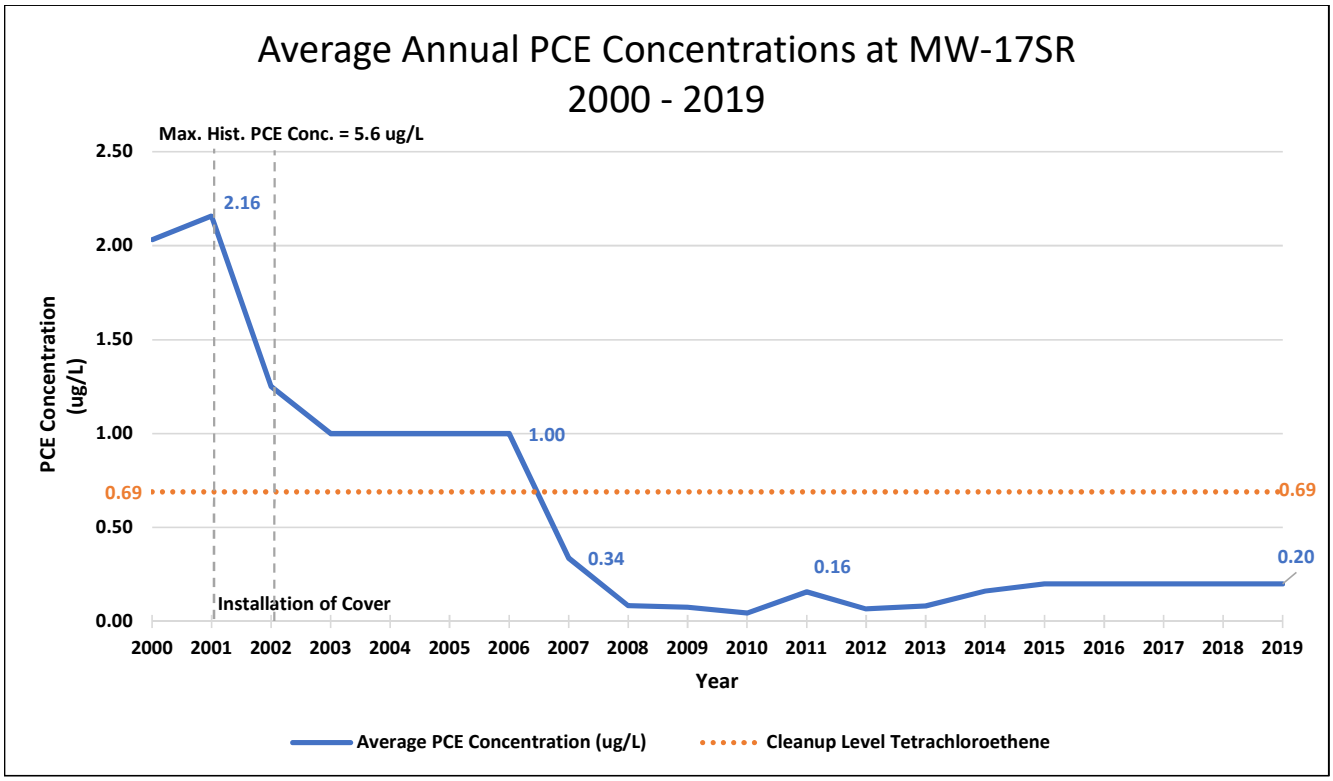
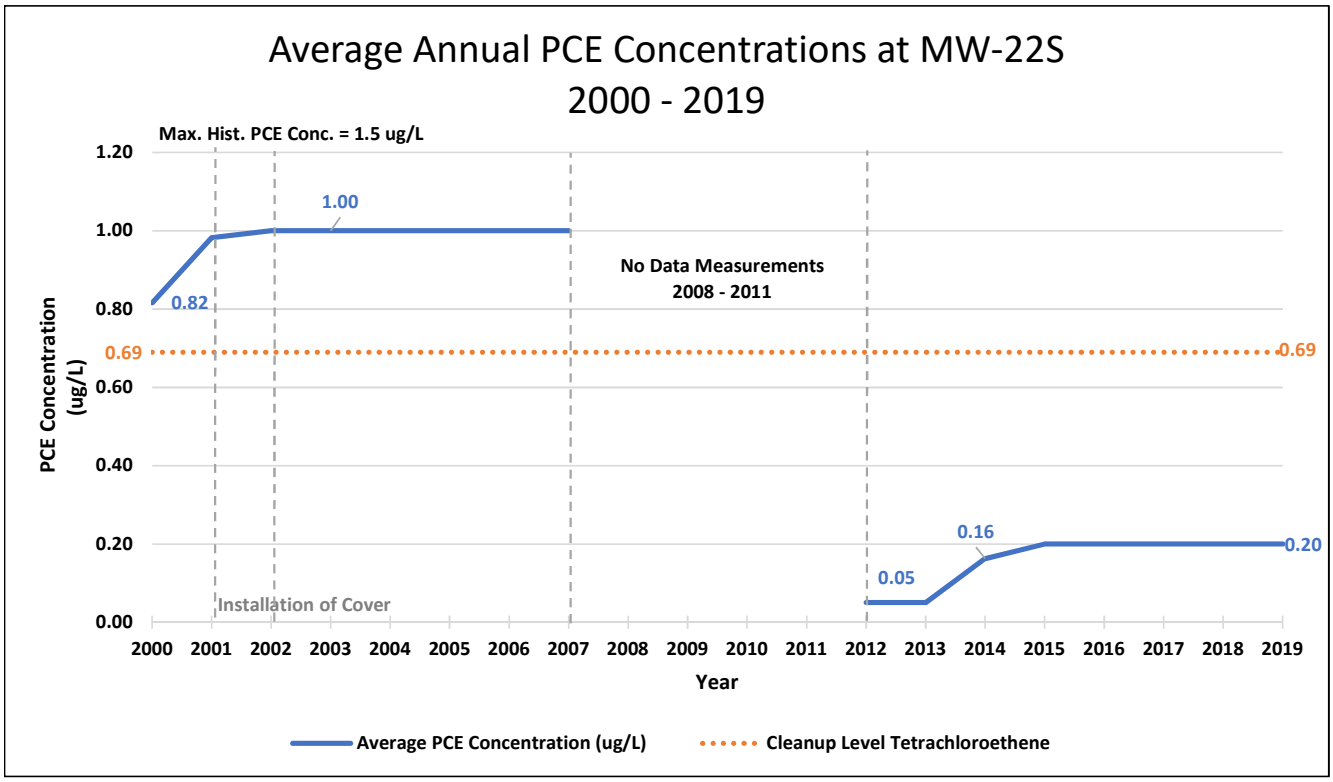

Average Annual TCE Concentrations at MW-23S
2000 - 2019
Max. Hist. TCE Conc. = 6.8 ug/L
TCE Concentration (ug/L)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
2.5
2.04
1.91
1.52
1.00
0.30
0.07
0.05
Installation of Cover
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Year
Average TCE Concentration (ug/L)
Cleanup Level Trichloroethene

EXHIBIT 6


Average Annual PCE Concentrations at MW-16S
2000 - 2019
Max. Hist. PCE Conc. = 11 ug/L
PCE Concentration (ug/L)
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.69
0.50
0.00
4.76
1.64
1.00
0.85
0.69
0.46
0.25
Installation of Cover
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Year
Average PCE Concentration (ug/L)
Cleanup Level Tetrachloroethene


Average Annual PCE Concentrations at LF-4R
2000 - 2019
Max. Hist. PCE Conc. = 20 ug/L
PCE Concentration (ug/L)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.69
0.00
4.00
9.29
2.28
0.87
1.38
0.63
0.69
Installation of Cover
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Year
Average PCE Concentration (ug/L)
Cleanup Level Tetrachloroethene


Average Annual PCE Concentrations at MW-17SR
2000 - 2019
Max. Hist. PCE Conc. = 5.6 ug/L
2.16
1.00
0.34
0.16
0.20
0.69
Installation of Cover
PCE Concentration (ug/L)
Year
Average PCE Concentration (ug/L)
Cleanup Level Tetrachloroethene


Average Annual PCE Concentrations at MW-22S
2000 - 2019
Max. Hist. PCE Conc. = 1.5 ug/L
1.00
0.82
No Data Measurements
2008 - 2011
0.69
0.16
0.05
0.20
Installation of Cover
PCE Concentration (ug/L)
Year
Average PCE Concentration (ug/L)
Cleanup Level Tetrachloroethene

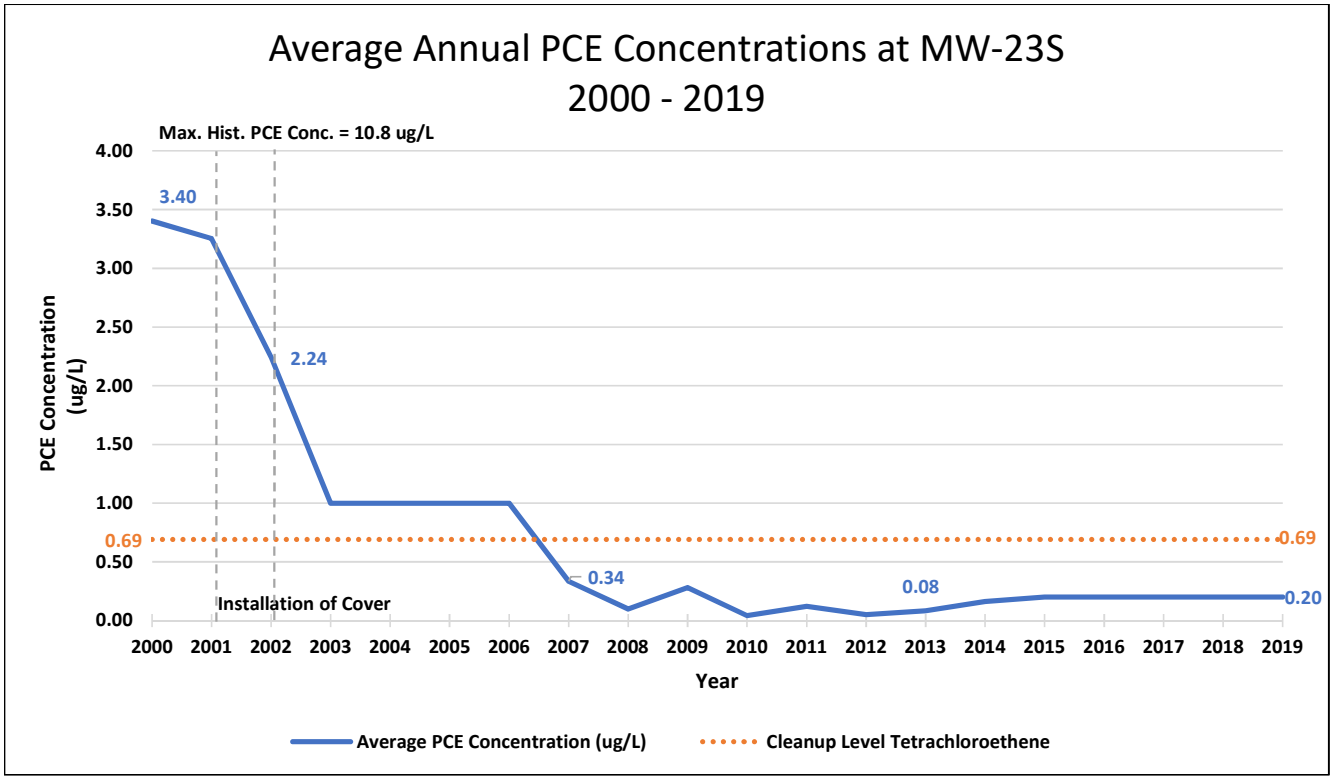

Average Annual PCE Concentrations at MW-23S
2000 - 2019
Max. Hist. PCE Conc. = 10.8 ug/L
PCE Concentration (ug/L)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.69
0.50
0.00
3.40
2.24
0.34
0.08
0.20
0.69
Installation of Cover
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Year
Average PCE Concentration (ug/L)
Cleanup Level Tetrachloroethene

EXHIBIT 7

Annual MSW Landfill Cover Inspections
Natural Disturbances

No stormwater erosion or settlement has ever been observed during any MSW Landfill Cover Inspection. Regular wind erosion has required minor repairs to the soil and vegetative cover on three occasions (following inspections in 2006, 2012 and 2017). No other repairs have been required during the period for which Annual MSW Cover Inspection data was available (2005 - 2018).

Year	Date	Wind Erosion	Stormwater Erosion	Settlement	Sparse Vegetation	Distressed Vegetation	Repairs Required?	Comments on Required Repairs
2005	04/14/05	Yes	No	No	Yes	No	No	N/A
2006	05/02/06	Yes	No	No	Yes	No	Yes	Repairs for wind erosion: wind erosion down to the geotextile in 3 places: on the south side between EW-11 and EW-20, between HC-1 and EW-9, and uphill of EW-13
2007	04/12/07	Yes	No	No	Yes	No	No	N/A
2008	04/30/08	Yes	No	No	Yes	No	No	N/A
2009	05/01/09	Yes	No	No	Yes	No	No	N/A
2010	05/28/10	Yes	No	No	Yes	No	No	N/A
2011	05/20/11	Yes	No	No	Yes	No	No	N/A
2012	05/24/12	Yes	No	No	Yes	No	Yes	Repairs for wind erosion: three foot diameter area eroded down to the geotextile, 50 feet SW of EW-11
2013	12/11/13	Yes	No	No	Yes	No	No	N/A
2014	12/11/14	Yes	No	No	Yes	No	No	N/A
2015	12/10/15	Yes	No	No	Yes	No	No	N/A
2016	12/15/16	Yes	No	No	Yes	No	No	N/A
2017	12/05/17	Yes	No	No	Yes	No	Yes	Repairs for wind erosion: soil cover eroded to the fabric in a small area above the drainage layer on the ridge at the SE corner of the Landfill.
2018	12/04/18	Yes	No	No	Yes	No	No	N/A

Source: Annual Reports, Pasco Municipal Solid Waste Disposal Areas, 2005 - 2018

EXHIBIT 8

No differential settlement has occurred at the MSW Landfill since the cover was installed in 2002. The topography at the MSW landfill has remained the same, and no indentations or collapses in the landfill cover have ever been observed.

Photo of portion of MSW Landfill cover in 2010

Photo of same portion of MSW Landfill cover in 2019

EXHIBIT 9

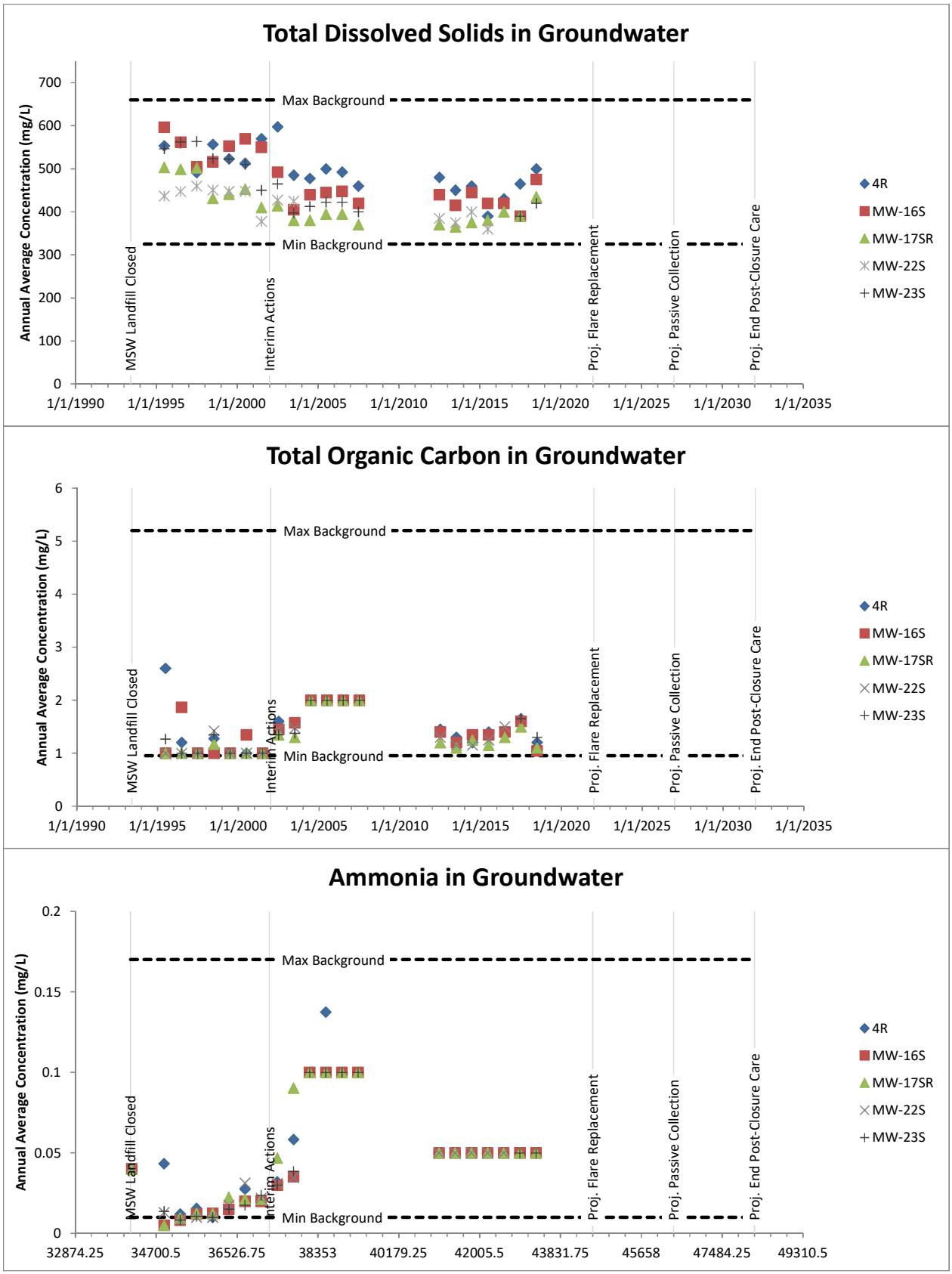

Total Dissolved Solids in Groundwater
Annual Average Concentration (mg/L)
700
600
500
400
300
200
100
0
Max Background
Min Background
MSW Landfill Closed
Interim Actions
Proj. Flare Replacement
Proj. Passive Collection
Proj. End Post-Closure Care
1/1/1990
1/1/1995
1/1/2000
1/1/2005
1/1/2010
1/1/2015
1/1/2020
1/1/2025
1/1/2030
1/1/2035
4R
MW-16S
MW-17SR
MW-22S
MW-23S
Total Organic Carbon in Groundwater
Annual Average Concentration (mg/L)
6
5
4
3
2
1
0
Max Background
Min Background
MSW Landfill Closed
Interim Actions
Proj. Flare Replacement
Proj. Passive Collection
Proj. End Post-Closure Care
1/1/1990
1/1/1995
1/1/2000
1/1/2005
1/1/2010
1/1/2015
1/1/2020
1/1/2025
1/1/2030
1/1/2035
4R
MW-16S
MW-17SR
MW-22S
MW-23S
Ammonia in Groundwater
Annual Average Concentration (mg/L)
0.2
0.15
0.1
0.05
0
Max Background
Min Background
MSW Landfill Closed
Interim Actions
Proj. Flare Replacement
Proj. Passive Collection
Proj. End Post-Closure Care
32874.25
34700.5
36526.75
38353
40179.25
42005.5
43831.75
45658
47484.25
49310.5
4R
MW-16S
MW-17SR
MW-22S
MW-23S

EXHIBIT 10

Inventory of Landfills from Ecology's Confirmed and Suspected Contaminated Sites List at which Geomembrane Caps were Installed in Response to Groundwater Contamination

NO LANDFILL COVER HAS EVER BEEN REPLACED, NOR HAS THERE EVER BEEN A REQUIREMENT FOR FUTURE REPLACEMENT, AT THESE WASHINGTON STATE LANDFILLS

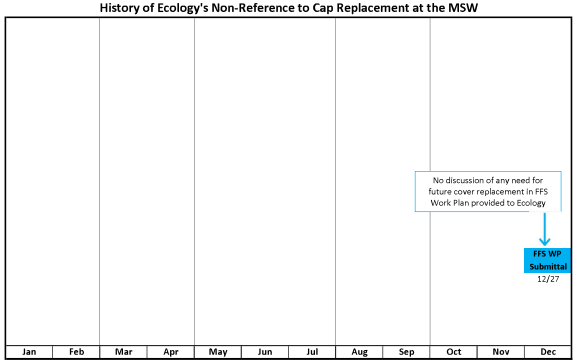
Cleanup Site ID	Site Name	County	Site Discovery OR Investigation / NPL Designation
7027	Cedar Hills	King	1992
2657	Centralia Landfill	Lewis	1990 / 1991
3035	Colbert Landfill	Spokane	1984
220	Cornwall Avenue Landfill	Whatcom	1992 / 1992
1308	Enumclaw Landfill	King	1988
1692	Grant County Ephrata Landfill	Grant	1984 / 1990
1019	Greenacres Landfill	Spokane	1987 / 1990
695	Hansville Landfill	Kitsap	1987 / 1991
3649	Hidden Valley Landfill	Pierce	1985 / 1990
3153	Inman Landfill	Skagit	1990
4428	Kent Highlands Landfill	King	1987 1990 / 1990
3019	Leichner Brothers Landfill	Clark	1987 1990 / 1990
1020	Mica Landfill	Spokane	1984 / 1990
2500	Northside Landfill	Spokane	1988 / 1990
4217	Olympic View Sanitary Landfill	Kitsap	1993 / 1993
4061	Ryegrass Landfill	Kittitas	1998 / 1998
4729	Seattle Public Utilities Midway Landfill	King	1990 / 1990
1183	Southside Landfill	Spokane	1984 / 1985
654	Tacoma Landfill	Pierce	1986 / 1995
1146	Vashon Island Landfill	King	1988
585	WA ECY Manchester Lab	Kitsap	1994 1995 / 1995
4087	Waste Management Greater Wenatchee Landfill	Douglas	1988
947	Wilder Landfill	Whatcom	1990 / 1990

EXHIBIT 11

Timeline Preview Page

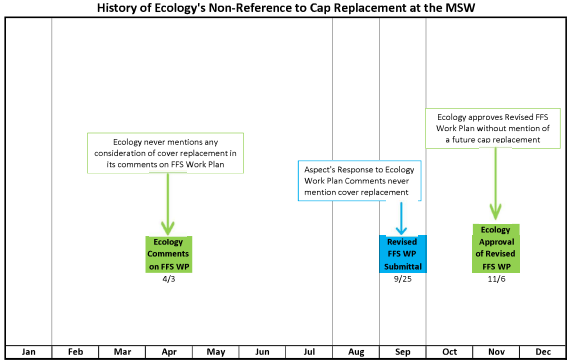
2012

History of Ecology's Non-Reference to Cap Replacement at the MSW



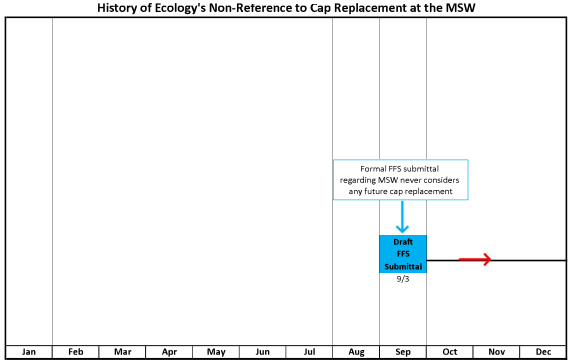
2013

History of Ecology's Non-Reference to Cap Replacement at the MSW



2014

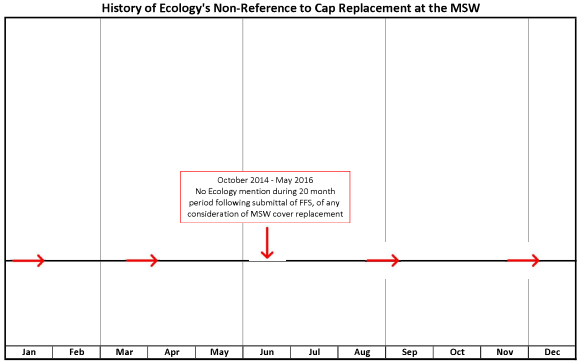
History of Ecology's Non-Reference to Cap Replacement at the MSW



2012 - 2018: No Reference to Cap Replacement at the MSW

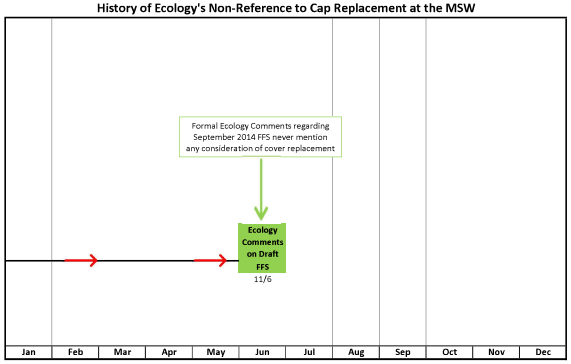
2015

History of Ecology's Non-Reference to Cap Replacement at the MSW



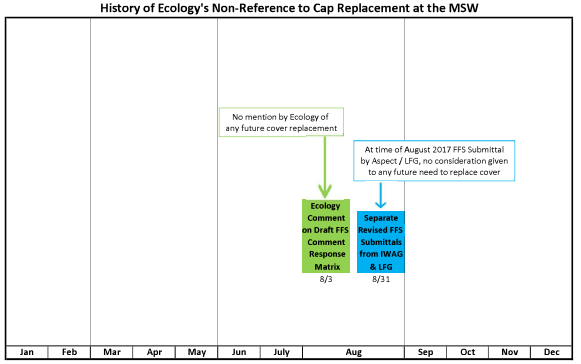
2016

History of Ecology's Non-Reference to Cap Replacement at the MSW



2017

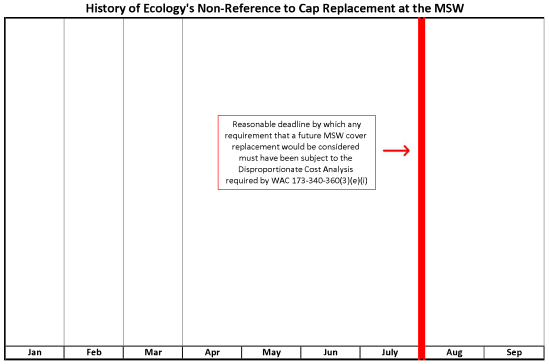
History of Ecology's Non-Reference to Cap Replacement at the MSW



2018

January - September 2018

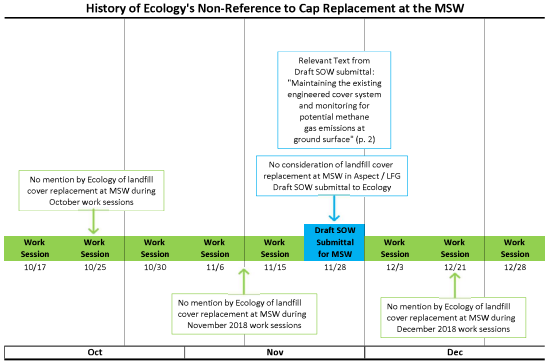
History of Ecology's Non-Reference to Cap Replacement at the MSW



2018

October - December 2018

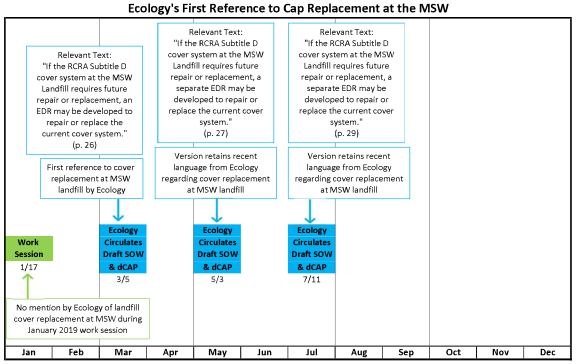
History of Ecology's Non-Reference to Cap Replacement at the MSW



2019

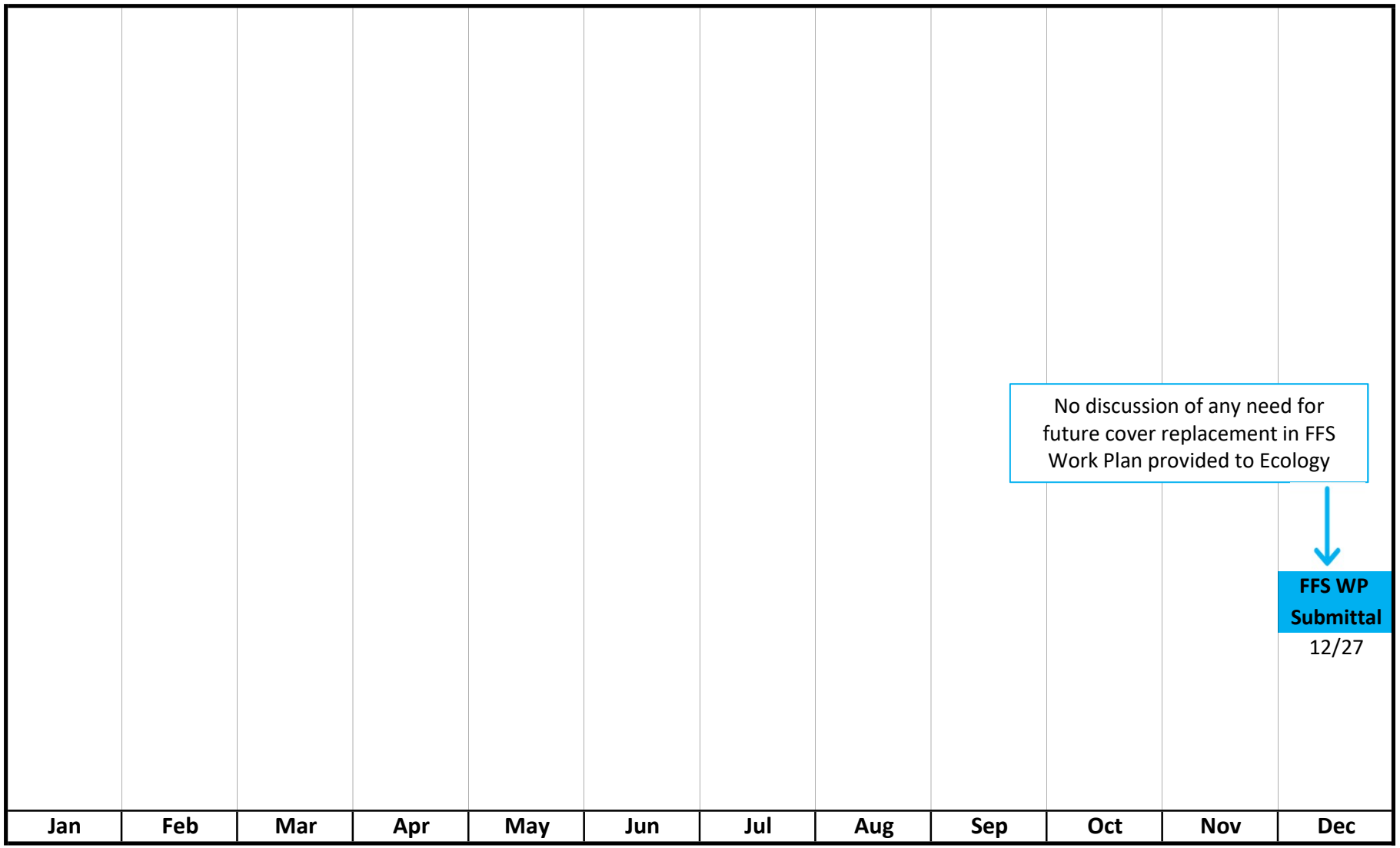
First Reference to Cap Replacement at the MSW

Ecology's First Reference to Cap Replacement at the MSW



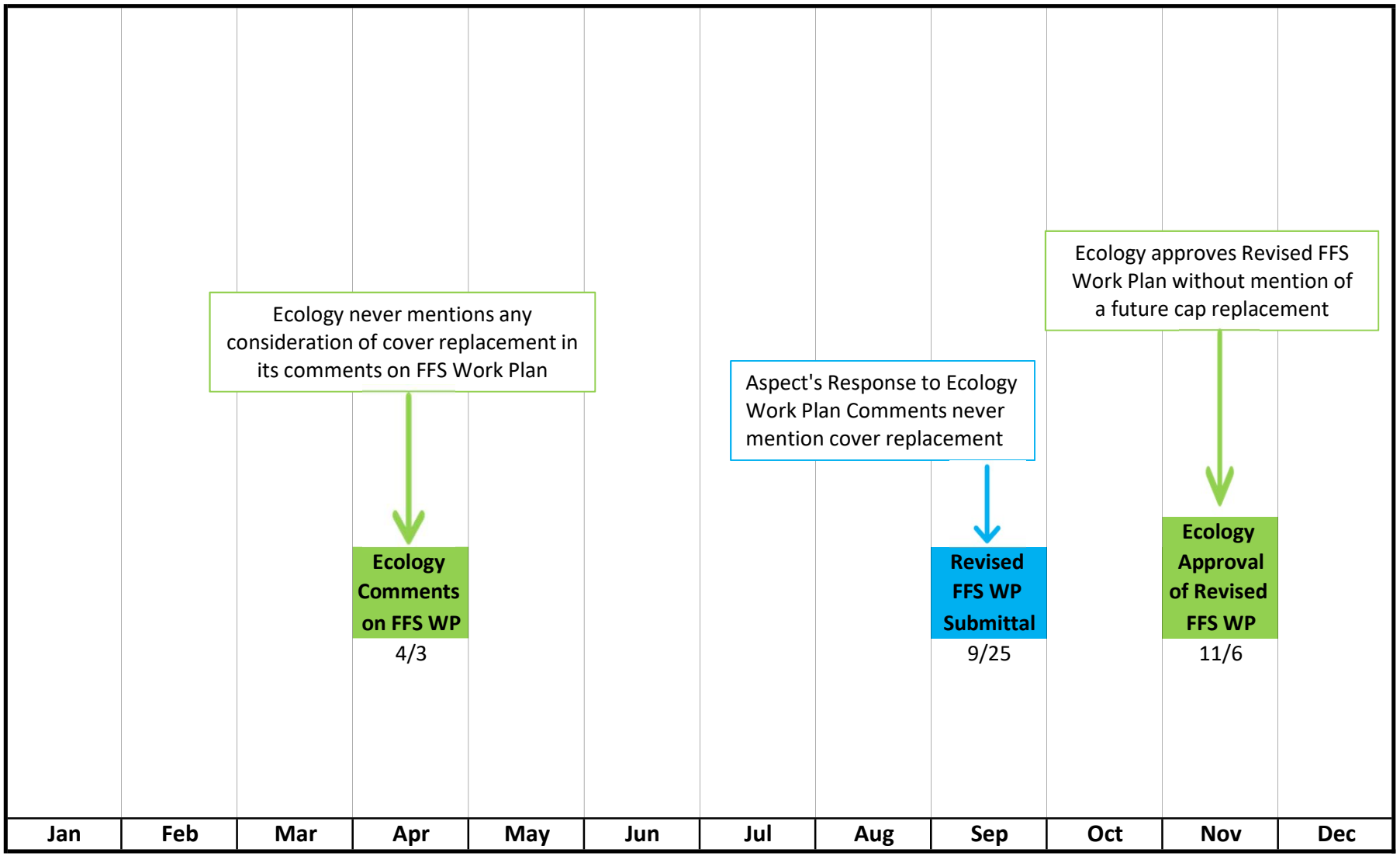
2012

History of Ecology's Non-Reference to Cap Replacement at the MSW



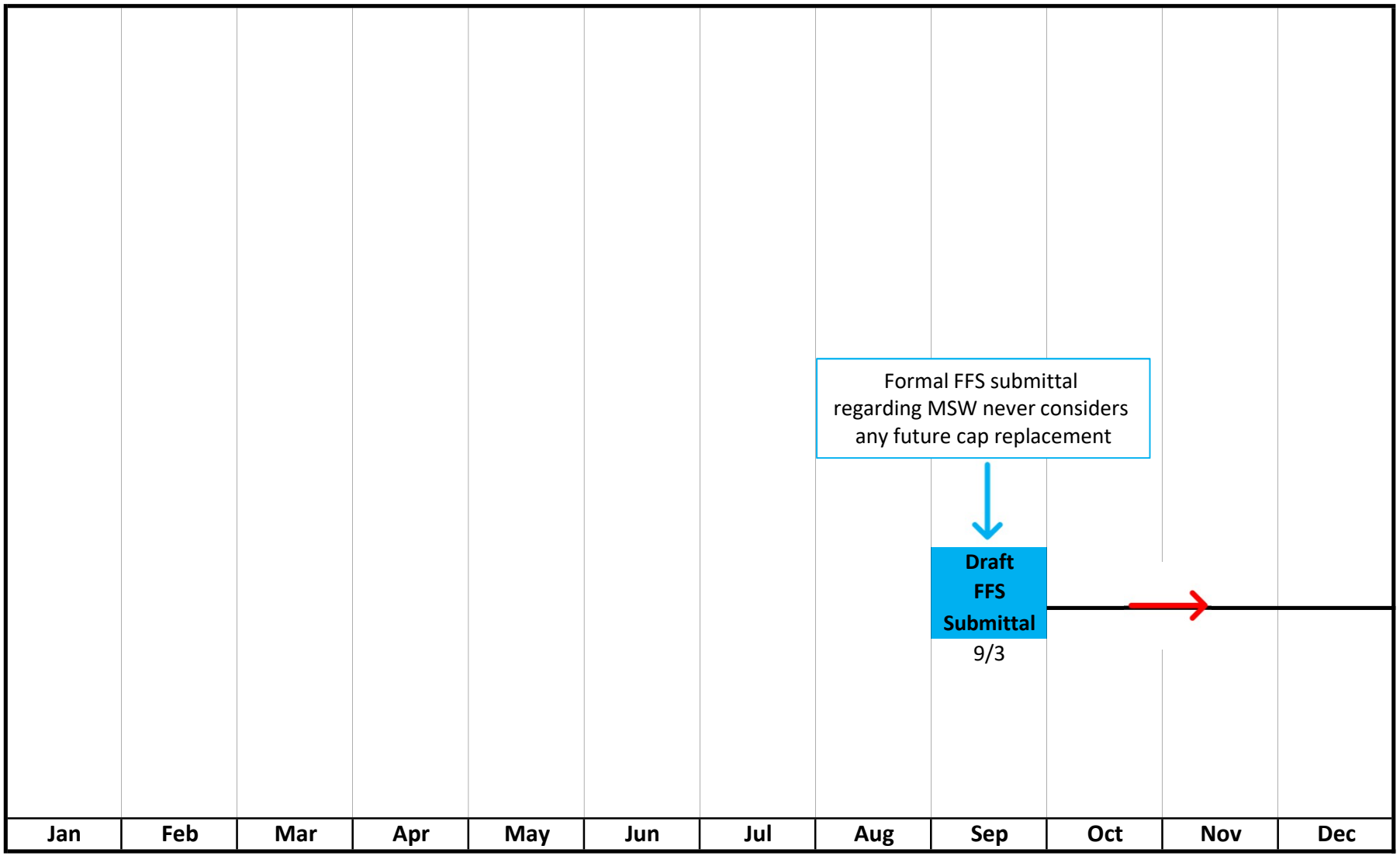
2013

History of Ecology's Non-Reference to Cap Replacement at the MSW



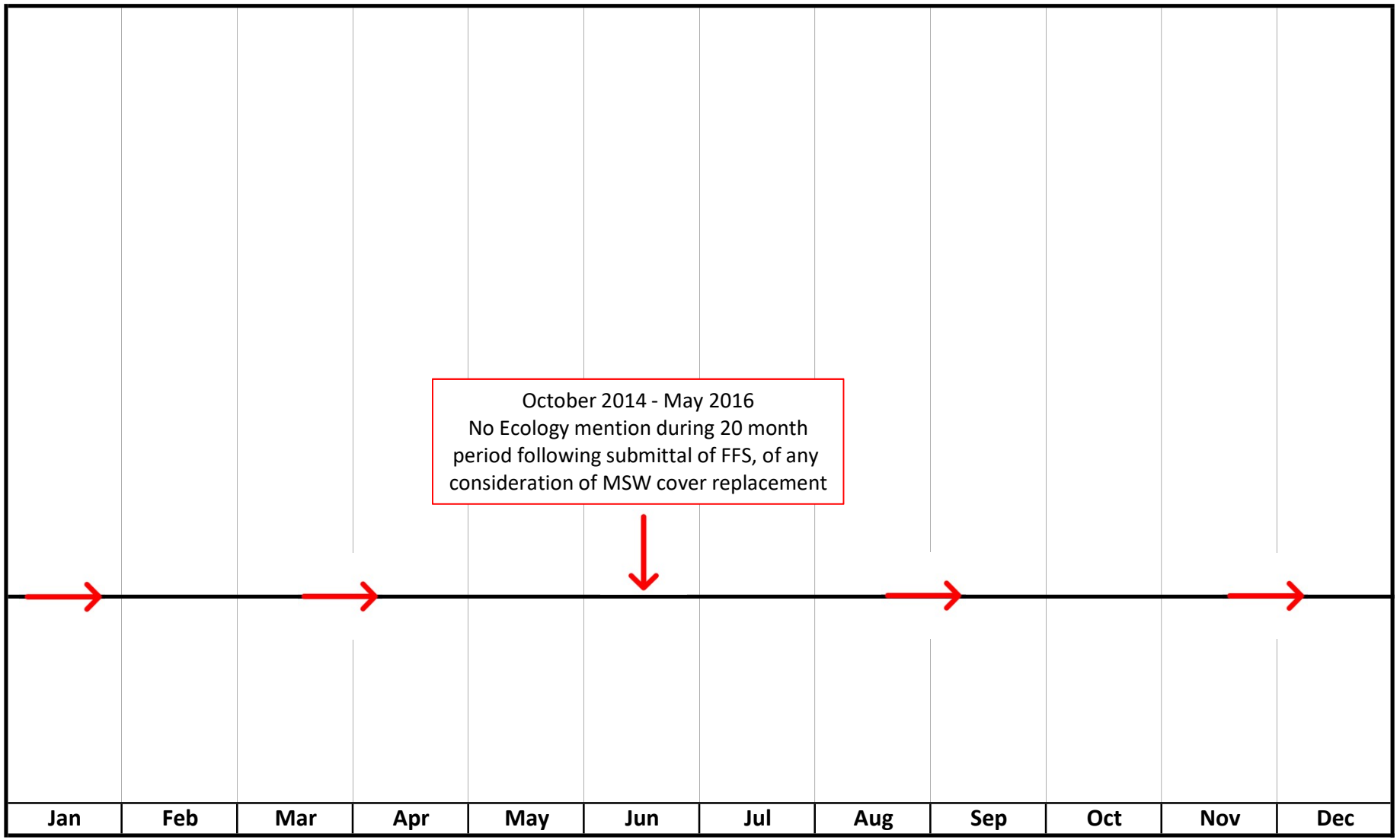
2014

History of Ecology's Non-Reference to Cap Replacement at the MSW



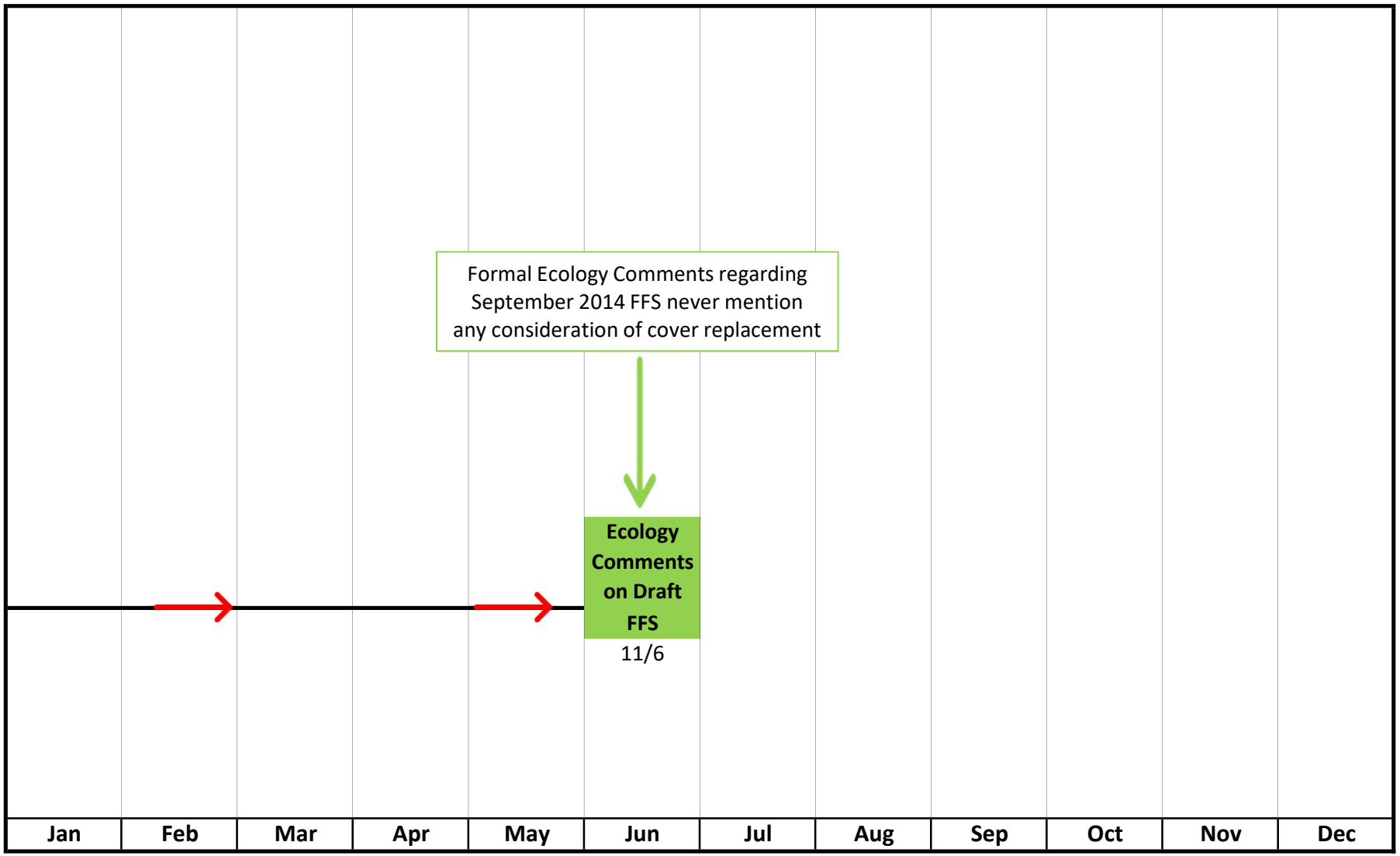
2015

History of Ecology's Non-Reference to Cap Replacement at the MSW



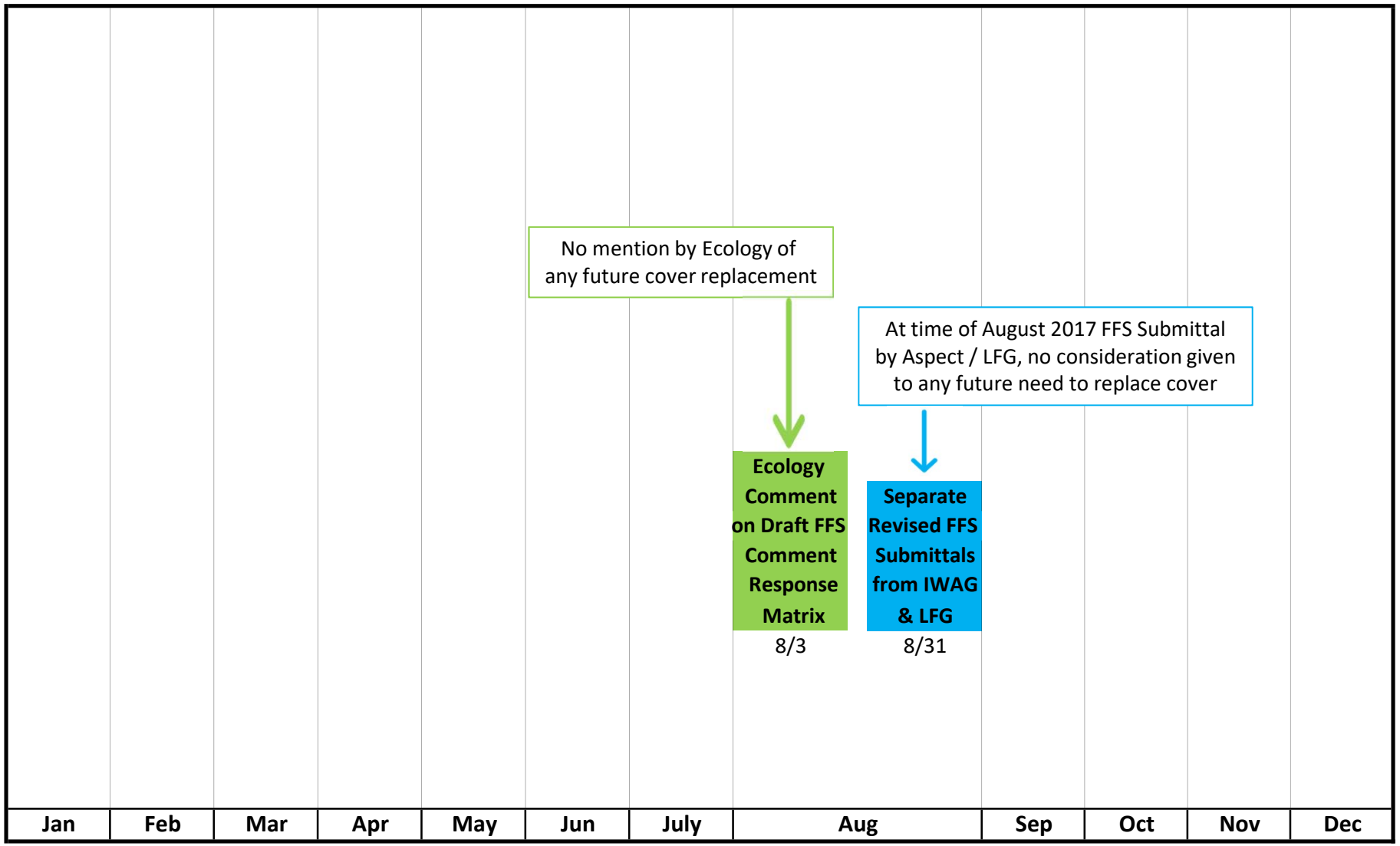
2016

History of Ecology's Non-Reference to Cap Replacement at the MSW

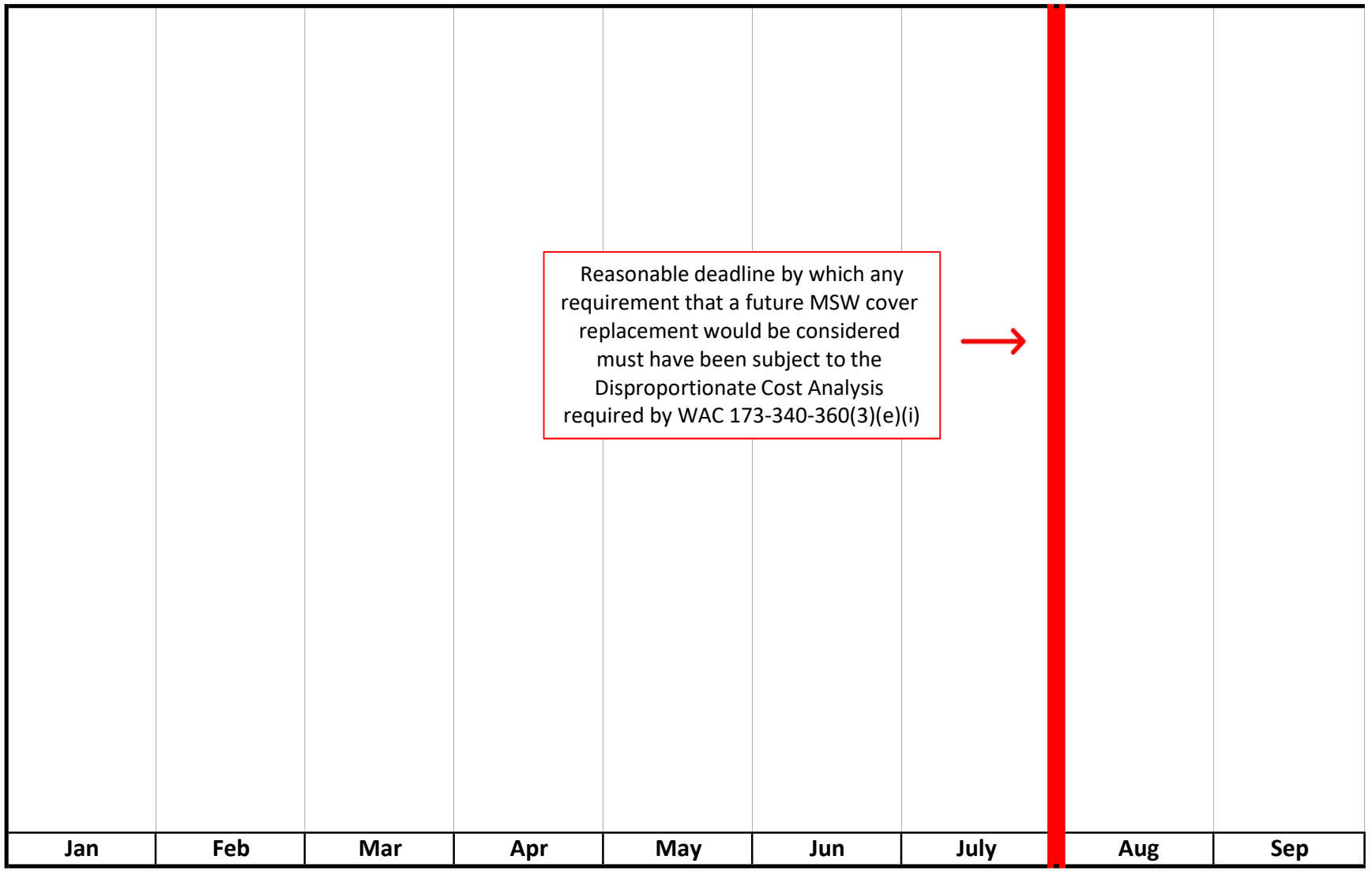


2017

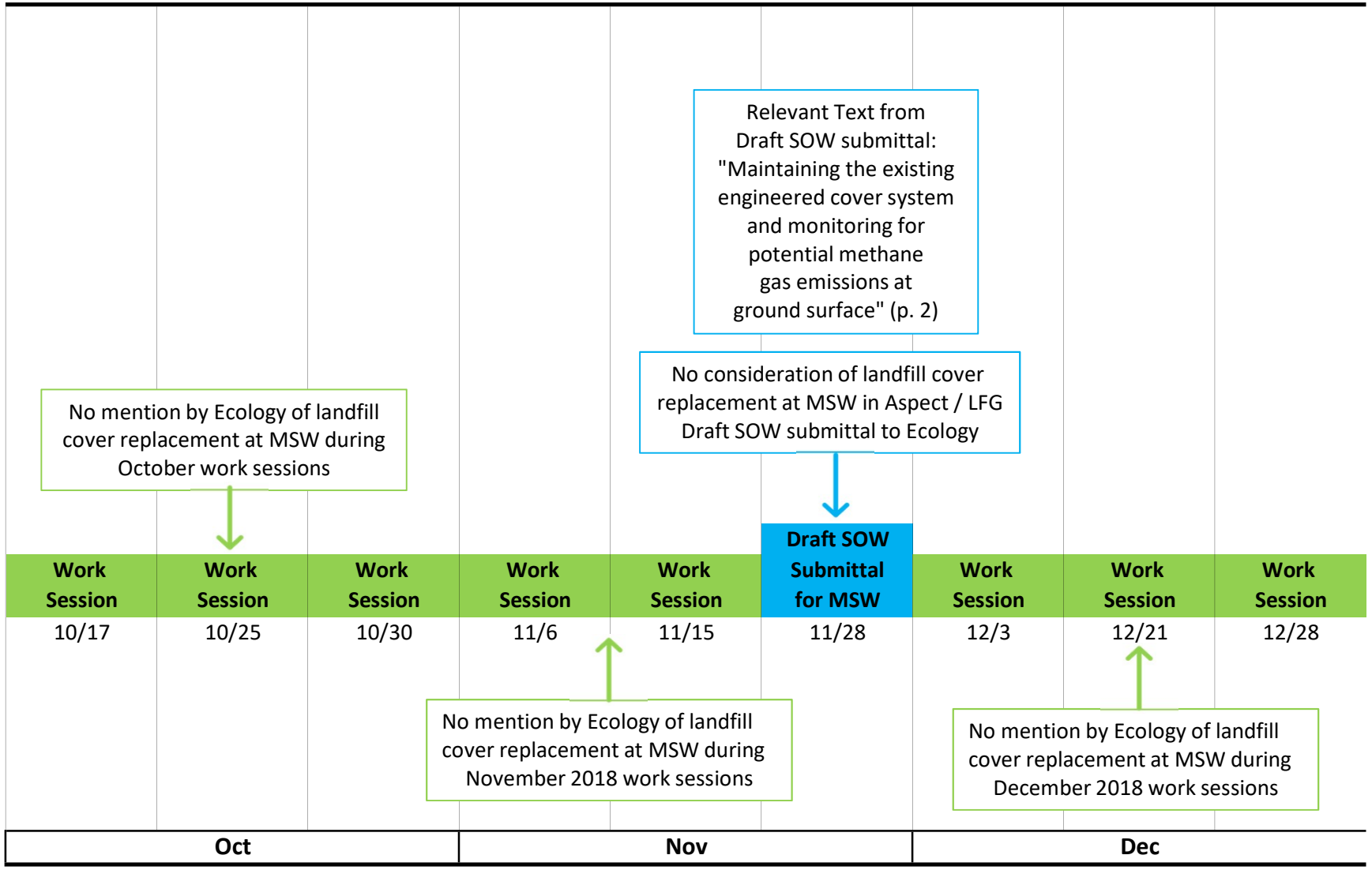
History of Ecology's Non-Reference to Cap Replacement at the MSW



January - September 2018
History of Ecology's Non-Reference to Cap Replacement at the MSW



October - December 2018
History of Ecology's Non-Reference to Cap Replacement at the MSW



2019
Ecology's First Reference to Cap Replacement at the MSW