ONTARIO ENERGY BOARD

IN THE MATTER OF the *Ontario Energy Board Act*, *1998*, S.O. 1998, c. 15, (Schedule B);

AND IN THE MATTER OF an application by EPCOR Natural Gas Limited Partnership for approval to change gas distribution rates and other charges effective January 1, 2020 to December 31, 2024.

AFFIDAVIT OF BRIAN LIPPOLD

(AFFIRMED DECEMBER 4, 2019)

I, Brian Lippold, of the City of London, in the Province of Ontario, MAKE OATH AND SAY:

1. I am the General Manager of EPCOR Natural Gas Limited Partnership (**"ENGLP"**) and have been employed in this capacity since November 2017. I was previously employed as the General Manager of Natural Resources Gas Limited (**"NRG"**) from November 13, 2013 to November 2017, at which time ENGLP purchased the entire Aylmer natural gas distribution system from NRG. As such, I have knowledge of the matters to which I depose to in this Affidavit. Where my knowledge is based on information, I have identified the source of that information and I verily believe that information to be true.

2. From November 1, 2018 to November 12, 2019, I took a medical leave of absence from my role as General Manager of ENGLP. During my medical leave, I was not contacted by ENGLP regarding my duties as General Manager of ENGLP.

3. I make this Affidavit in support of a Motion (the **"Motion to Review")** by ENGLP for an Order pursuant to Rules 40 and 42 of the Ontario Energy Board's (the "**Board**" or the "**OEB**") Rules of Practice and Procedure (the "**Board's Rules**") that the Board

review and vary the Board's Decision and Order of October 24, 2019 in proceeding EB-2018-0336 (the "**Decision**") in respect of the Board's decision to disallow the inclusion of the capital cost of the Putnam to Culloden Pipeline (as defined below) in ENGLP's 2020 rate base.

Purpose of this Affidavit

4. On January 31, 2019 ENGLP filed a cost of service rate application for the period January 1, 2020 to December 31, 2024, in proceeding EB-2018-0336 (the **"Application"**). This was the first rate case filed by ENGLP since acquiring natural gas distribution system from NRG. A map depicting ENGLP's distribution system is attached to this affidavit as Exhibit "**A**".

5. I am advised that in its Decision and Interim Rate Order dated July 4, 2019, the Board approved a settlement on all issues with respect to the Application but deferred the determination of a single issue, namely the prudence of four projects completed by NRG in 2016 and 2017 to address system integrity issues (the **"Four System Integrity Projects"**). The Four System Integrity Projects and their associated 2020 net book (rate base) values are:

   a. $402,639 for the Enbridge Gas Inc. (**"Enbridge"**), formerly Union Gas Limited (**"Union"**), Bradley Station Project (the **"Bradley Station Project"**);

   b. $748,383 for the pipeline from the Bradley Station to the Wilson Line project (the **"Bradley to Wilson Line Project"**);

   c. $498,922 for the pipeline from the existing Putnam Station to Culloden Line project (the **"Putnam to Culloden Pipeline"**); and

   d. $265,015 for the extension of the Springwater Road pipeline from south of Orwell to John Wise Line project (the **"Springwater Pipeline"**).

6. I am further advised that the Board scheduled Phase 2 of the EB-2018-0336 proceeding to review the prudence of the Four System Integrity Projects and that the Board issued the Decision, which disallowed the inclusion of the Putnam to Culloden

Pipeline in ENGLP's rate base for at least the January 1, 2020 – December 31, 2024 period.

7. In my role as General Manager of NRG, I was deeply involved in addressing system integrity issues, including the planning and implementation of the Four System Integrity Projects. However, due to my medical leave, which extended through a portion of the pre-filing assembly of evidence for the Application, as well as the discovery and written hearing process for the Application, I was unable to provide information in support of the Application. As noted above, during my leave I was not contacted by ENGLP to obtain any information in my possession in support of the Application.

8. As a result, I affirm this affidavit to assist the OEB in understanding the prudency of NRG's capital expenditure on the Putnam to Culloden Pipeline by providing information which was not previously placed in evidence in the proceeding and could not have been discovered by reasonable diligence until my return from medical leave.

Role as General Manager and the Four System Integrity Projects

9. My employment as General Manager of NRG commenced when I was recruited by NRG in the summer of 2013. In that capacity, I introduced changes to NRG's operations, including enhancing safety practices, improving the relationship between customers and the utility, implementing a change management program, and making recommendations on the utility's secondary lines of business.

10. As General Manager, one of my key responsibilities was to ensure the safe operation of the utility for the benefit of, among others, employees and customers.

11. At the outset of my employment, in the fall of 2013 and winter of 2014, I observed that emergency work on the Northeast and Southwest quadrants of NRG's distribution system was commonplace. After further investigation, I concluded that there were a number of calls related to required pressure adjustments in the Northeast and Southwest quadrants of the system.

12. During exceptionally cold conditions, I observed that the system required hour by hour, and sometimes minute by minute, monitoring due to the system's low pressure issues. At that time, the control stations lacked an alarm mechanism with the exception of one dedicated 6-inch high pressure steel line. Therefore, in order to monitor the pressure in the system, the Operations Manager would recommend pressure adjustments based on readings that were manually collected by calling into the various control stations.

13. These circumstances required NRG's Operations Manager to routinely work very long hours in order to monitor system pressures and to dispatch technicians to adjust pressures and pack the system so that customers would have uninterrupted access to heat and hot water. The dispatch technicians would often have to attend control stations alone, in the dark, and at temperatures below -20 degrees Celsius. Staff worked hard, in challenging circumstances, to preserve enough gas flow to avoid major disruptions. These dispatch calls were directly caused by low system integrity issues and, in my view, had to be eliminated for both safety and cost reasons.

14. The root cause of the observed low pressure conditions was poor movement of natural gas within NRG's distribution system.

15. As a result of the low pressure issues, I was very concerned with:

    a. ensuring employee safety in the monitoring and adjustment of system pressures;

    b. the potential for catastrophic system outages;

    c. the potential for unintended interrupted service to residential customers who rely on services for home heating and whose interrupted service could pose a significant risk to personal and public safety; and

    d. the potential for interrupted service to industrial-commercial customers that would adversely impact crop and livestock businesses.

16. It was clear that effectively and expeditiously resolving the low pressure issues in the Northeast and Southwest quadrants required improving system supply and gas flow. Therefore, these objectives became a priority in the years following 2013.

17. The above-noted concerns were augmented in the fall 2014, when low gas supply and pressures culminated in the interruption of service to industrial-commercial customers, who had an uninterruptible contract, in the Northeast and Northwest quadrants.

18. The fall 2014 service interruptions arose due to a delayed grain drying season, that overlapped with prolonged periods of sub-zero temperatures, and which created an unsustainable demand for gas from both industrial-commercial customers and residential customers. Consequently, NRG experienced system pressure drops in the Northeast quadrant near Brownsville, to as low as 5 psi. When the pressure drops below 10 psi, there is a serious risk of system outages.

19. During the fall of 2014 and thereafter, NRG was very concerned about possible outages to residential and other firm customers, which posed a safety, economic and reputational risks.

20. Furthermore, the utility experienced, and continues to experience, historical growth at an average annual rate of 2% - 3.5% (approximately 245 customers per year). This growth adds to the pressure faced by the utility to alleviate insufficient flows. In particular, since 2014, the utility has faced pressures to add new industrial customers and ensure utility service for new housing developments.

21. NRG targeted implementing a system integrity solution to low system pressures prior to November 1, 2015, in advance of the heating season and to avoid potentially catastrophic issues similar to those faced by the utility in the heating season of November 2014.

NRG's Significant Efforts to Secure a Solution to Low Pressure Issues with Union Gas

22. Due to low pressure issues in the Northeast and Southwest quadrants of NRG's distribution system, in 2014 and 2015 I engaged in discussions, and held meetings with, representatives of Union Gas ("**Union**") to:

    a. inform Union of NRG's gas supply problems;

    b. request additional gas supply and pressures from Union; and

    c. propose various potential system integrity solutions for Union's feedback and consideration.

23. During these discussions with Union, NRG emphasized the need for a solution to system pressure issues in its primary area of concern, the Northeast quadrant.

24. Between April 2015 and November of 2015, I met and corresponded with Union on multiple occasions with the goal of exploring low system supply and pressure solutions. NRG took the lead in developing proposed solutions and diligently sought information and feedback from Union in order to assess their viability.

25. By 2015, NRG's efforts to obtain additional gas from Union had been frustrated by what NRG considered to be Union's uncooperative, unresponsive and dismissive responses. These efforts culminated in NRG filing a "failure to serve" application with the Board, on November 6, 2015, in proceeding EB-2015-0308, citing significant risks to its customers if Union failed to provide the requested load.

26. NRG was seeking an incremental load of 3,700 m^3 per hour with a minimum pressure of 120 psi and was hoping to achieve this objective through a solution that fell below the Board's leave-to-construct threshold, as avoiding a leave to construct application would result in a solution that could be implemented more quickly and at lower costs.

27. In discussions with Union, NRG explored several options, including, the following six options primarily aimed at tying into the Union system to address insufficient flows:

a. *Convert the Union-owned regulating and relief station located on Putnam Road south of the Community of Mossley (the **"Putnam-Mossley Station"**) into a custody transfer station:* This option was initially considered viable by NRG owing to the presence of a Union high pressure steel pipeline near Mossley, which NRG thought could provide additional gas supply into the system and alleviate seasonal low pressure issues in the immediate vicinity of the station and seasonal pressures in the Northeast quadrant of the NRG system and in the Town of Aylmer.

Following correspondence with Union, NRG was prepared to accept lower pressure gas at the station in light of Union's preliminary view that expensive reinforcements would be necessary. There were significant delays from Union in responding to requests for information to better assess this option. Ultimately, Union estimated total reinforcement and construction costs payable by NRG at approximately $13.6 million, which would trigger a leave-to-construct application.

In October 23, 2015, NRG instructed Union to proceed with the Putnam-Mossley Station option and file a leave-to-construct application as quickly as possible. This option would have increased additional gas volumes and pressures to the Northeast quadrant. However, on November 2, 2015, Union advised that it had concerns about NRG building facilities at the Putnam-Mossley station and suggested an alternative location at the Union/NRG franchise border. These changed circumstances would have required a steel pipe to bridge the two stations, resulting in additional costs.

b. *Tie into Union's system north of the Town of Tillsonburg, in or around Union's high pressure gas line near Mount Elgin, located in the Township of South-West Oxford and at a Union regulating and relief station at Mount Elgin (the **"Mount Elgin Station"**):* This option was considered only as a contingency. NRG management ultimately determined that this was not a viable option to alleviate low pressures in the Northeast area of the system since it would have required drilling underneath the community of Mount Elgin. Union estimated total reinforcement and construction costs payable by NRG at $11.6 million, which would trigger a leave-to-construct application.

c. *Purchase or lease Union-owned surplus land near the Putnam-Mossley Station in order to construct a custody transfer station:* This option was aimed at alleviating low pressures in the northeast area of the system. It was ruled out after Union advised that it was not prepared to sell or lease the desired lands.

d. *Tie into to the south portion of the Zenda Line into Town of Tillsonburg where there is a 6 inch high pressure line that is back-fed by a number of wells that supply into Union's system:* NRG management ultimately determined that this option was not viable because the topography of the area (uneven terrain and rivers) would have resulted in high construction costs and the proposed tie-in would not be in close enough proximity to the low pressure areas in the Northeast quadrant. This option would have reduced NRG's reliance on local premium gas from NRG Corp., at the expense of approximately $15-20 million in reinforcement and construction costs payable by NRG.

e. *Increasing pressure from Union supplies into the Brownsville area:* NRG management determined that this option was not viable because supply from Union was capped at 80 psi.

f. *Increasing gas supply from Union in the Southeast quadrant of the system:* NRG management determined that this option was not viable due to the high cost associated with reconfiguring the NRG system in the south to address the uptake of gas from small diameter lines and undersized valves and connections.

28. The above-noted options (a) to (e) were aimed at alleviating low pressure issues in the Northeast quadrant near Brownsville. These options were not ideal because they involved prohibitively costly reinforcements, and/or could potentially trigger a lengthy regulatory process that would have further delayed NRG's implementation of a system integrity solution in advance of the next heating season. Attached as Exhibit "**B**" to

this Affidavit are maps and correspondence detailing NRG's exploration of the above-noted options.

29. A further option was explored which entailed NRG obtaining additional gas volumes from Union at the Bradley Station that would provide NRG with up to 3,700 m^3/hour at 150 psi of natural gas service**.** The following are salient facts regarding this option:

a. Union initially determined that this option required costly reinforcements in order to supply the requested increased load through Bradley Station, including a new pipeline in order to move gas to areas within NRG's franchise where it was needed. Union estimated project costs at $3.8 million, which would in turn require a leave-to-construct application. A cost reduction was possible once enhancements to the Union Lobo transmission station were completed.

b. In early September 2015, NRG corresponded with Union to determine whether Union could in fact supply the requested load. Meanwhile, on September 14, 2015, NRG advised Union that it was continuing with the construction of its pipeline and other infrastructure required to move gas from the Bradley Station to the northeast part of its franchise area.

c. On September 22, 2015, Union advised that enhancements to its Lobo transmission station were expected to be completed by November 1, 2016 and Union would possibly satisfy NRG's request for additional gas service at that date by providing gas through Bradley Station.

d. The Bradley Station option was not NRG's preference in comparison to the Putnam-Mossley Station option. However, management determined the costs of this option were more manageable and prudent, and considered that the project could be implemented and sufficiently responsive to NRG's system integrity issues within a reasonable time period.

e. In March 2016, Union agreed to provide NRG with additional gas supply at Union's Bradley Station. This agreement set in motion the implementation of the Four System Integrity Projects.

The SNC-Lavalin System Integrity Study Option vs. Putnam to Culloden Pipeline

30. In March 2016, SNC-Lavalin completed a report that summarized the results of system modelling and pressures, and recommended projects to address pressure issues experienced in the Northeast and Southwest quadrants (the **"SNC Study"**). Attached as Exhibit "**C**" to this Affidavit is a copy of the SNC Study.

31. The SNC Study was limited in scope, focusing on the extent to which NRG Corp. wells were required for system integrity purposes, and it did not take into account additional gas supplies secured from Union at the Bradley Station.

32. NRG did not ask SNC-Lavalin to revise its study based on the additional gas supply from Union because: (a) it would be costly and require a lengthy new system analysis; and (b) the time required to complete a new analysis and revise the study would likely result in significant delays to the resolution of inadequate flows that needed to be urgently addressed.

33. The SNC Study recommended the following pipeline to address low pressure issues in the Northeast quadrant near Brownsville:

> South on Lewis Road to Harrietsville Road and continuing south on Whittaker Road (4"), and then east on Wilson Line (proposed 3"), south on Pigram Line (2"), east on Ostrander Line (a proposed 3" line, parallel to the existing 2" line), and south on Brownsville Line to the area around Brownsville (3").

34. However, after analyzing its options (including the option proposed through the SNC Study) NRG determined that the most effective means of diverting gas supplies from the Putnam Station to areas in the Northeast near Brownsville, was directly through the Putnam to Culloden Pipeline:

> South from Putnam Station, east on Cromarty Drive and Salford Road (proposed 4"), briefly in a generally Northeast direction on Pigram Line (proposed 4"), and then south on Culloden Line to Ebenezer Road (proposed 3") to the area around Brownsville.

Attached as Exhibit **"D"** to this Affidavit is are drawings showing the proposed Putnam to Culloden Pipeline route (Phase I) as well as the Bradley Station to Wilson Line Project (Phase 2).

35. The Putnam to Culloden Pipeline was a superior option over the SNC-Lavalin option, for the following reasons:

    a. The SNC-Lavalin option would have created a 2" pipeline "choke point" potentially resulting in future pressure and reliability issues;

    b. The Putnam to Culloden Pipeline:

        i. Allowed for delivery of higher pressure gas into Brownsville by utilizing a larger pipeline diameter, along a more direct and shorter route, with fewer turns;

        ii. Did not rely on incremental pressure at Putnam Station to resolve the dangerously low pressure issues in the region; and

        iii. Provided secondary benefits, such as facilitating future growth where customer demand was known and improved reliability by implementing a two-way feed.

The Development and Implementation of the Putnam to Culloden Pipeline

36. The additional gas supply provided by Union at Bradley Station was not in close proximity to the Northeast quadrant of NRG's system where low system pressure posed the greatest risk to customers, nor was this additional gas supply in close proximity to the Southwest quadrant near Aylmer where low pressures were also a concern.

37. In June 2016 SNC-Lavalin provided NRG with a take-off analysis (the amount of gas that could be delivered to parts of the system at sufficient pressures) for the system supply lines from Bradley Station to the Wilson Line. The purpose of this take-off analysis was to determine how far south the utility could run a plastic pipeline solution

to increase pressures in the Aylmer area, which would in turn allow the Southwest quadrant to maintain its pressures.

38. The take-off analysis indicated that the system required a high pressure plastic pipeline (which required a variance from Canadian Standards Association standards), in order to provide sufficient gas volumes directly from the Bradley Station into the low pressure areas in the Southwest quadrant. This would in turn allow the Southwest quadrant to maintain reasonable pressures and also prevent migration of gas from the Northeast into other areas of the system.

39. Based on the results of the take-off analysis, NRG concluded that improving flows in the Northeast of the system from the Bradley Station would require a steel pipeline, triggering a leave to construct application. As an alternative, NRG elected to supply the Northeast with additional gas flows by way of a plastic pipeline fed locally from the Putnam Station.

40. NRG then determined that because the system was being bolstered in the west and southwest areas by the Bradley Station to Wilson Line, it could then divert gas from the Putnam station to achieve increased pressures in the Northeast quadrant. This resulted in the Northeast problem area being fed from a local station instead of drawing from other parts of the system, hence the Putnam to Culloden Pipeline was developed.

41. Therefore, after careful consideration, NRG determined that the new gas supply at the Bradley Station was most effectively managed as follows:

   a. *The Bradley Station Project*, which enables the distribution system to receive new Union gas at a higher receipt pressure from the Bradley Station;

   b. *The Bradley to Wilson Line Pipeline*, which packs the Southwest quadrant near Aylmer with sufficient gas quantities and pressures so they do not take away pressures from the North and East. This pipeline feeds directly into the Springwater Pipeline which directly supplies sufficient gas quantities and pressures to high risk areas south of Aylmer; and

c. *The Putnam to Culloden Line*, which establishes a pipeline independent from the other projects and increases gas pressures in the Northeast quadrant while also protecting the pull of gas away from the Northeast quadrant by tying into the local Putnam Station.

42. NRG determined that the Four System Integrity Projects would have the combined effect of increasing gas quantities and pressures in the areas where they were most needed. Attached as Exhibit "**E**" to this Affidavit is correspondence related to the SNC-Lavalin take-off analysis.

43. In order to achieve its intended effect, the Putnam to Culloden Pipeline did not require additional volume or pressure at Putnam Station (which would have required costly upstream reinforcements). This pipeline increased pressures in the Northeast quadrant near Brownsville because it had the effect of connecting the Putnam Station directly to the Northeast and thereby diverted gas volumes to crucial areas.

44. NRG further determined that the cost of the Four System Integrity Projects allowed management to act quickly to resolve its system integrity concerns and avoid construction delays from a leave-to-construct application.

The Putnam to Culloden Pipeline Should Not Have Been Deferred

45. The Putnam to Culloden Pipeline project was a priority project since it alleviated the dangerously low pressures documented in the Northeast quadrant near Brownsville. In fact, NRG determined that the Putnam to Culloden Pipeline was the most important of the Four System Integrity Projects.

46. As General Manager, I could not, for another heating season, continue to risk the safety of the Operations Manager and dispatch technicians who were continuously monitoring system pressures in challenging conditions, nor could I accept the risk of dangerous system outages or interrupted service to NRG's customers. These risks were particularly high in the Northeast quadrant of the system.

47. The availability of additional gas supply from Union at the Bradley Station was a clear change in circumstances that presented an opportunity for NRG to expeditiously

address its pressing system integrity concerns with viable solutions that had not been previously explored.

48. In summary, NRG's urgency in moving forward with the Putnam to Culloden Line was based on the following:

   a. The need to provide safe and reliable natural gas for all of its customers;

   b. The obligation to take steps to reduce the health and safety risks for employees associated with addressing low pressure in the Northeast over another winter;

   c. The need to alleviate pressure on NRG's limited staff and resources that were stretched in monitoring system pressures, in particular in the Northeast area near Brownsville;

   d. The need to eliminate the possibility of another November 2014 catastrophic event (customer service interruptions and dangerously low system pressures that could lead to system outages); and

   e. The desire to uphold the public's confidence in NRG's ability to provide safe, reliable natural gas within its service areas.

49. Since the only additional supply of gas was coming in from the Bradley Station, and the Northeast quadrant required additional volumes and pressure of gas in the Brownsville Area, NRG had no alternative but to build a pipeline to divert gas from the west to east of the system.

The Putnam to Culloden Pipeline had a Material Impact on System Integrity Issues

50. The Putnam to Culloden Pipeline successfully alleviated system integrity issues related to dangerously low pressures in the Northeast quadrant.

51. ENGLP is no longer observing significant low pressure issues in the Northeast quadrant near the Brownsville area. This observation is consistent with modelling of the system completed by Cornerstone Energy Services in 2018 (the "**Cornerstone**

Study"), which accounts for the impacts of the Putnam to Culloden Pipeline. Attached as Exhibit "**F**" of this Affidavit is a copy of the Cornerstone Study.

52. The outcome of improved flows in the Northeast quadrant has in turn alleviated the utility's pressing concerns regarding employee and public safety, interrupted services, system outages, and reputational damage.

The Putnam to Culloden Pipeline Improved System Reliability and Facilitated Future Unsubsidized Growth of the Distribution System

53. Although the primary objective of the Putnam to Culloden Pipeline was to address system integrity issues, two important secondary benefits of the line are: (i) improved system reliability; and (ii) the facilitation of future unsubsidized growth.

54. A good utility practice and sound system integrity principle is to loop a line in order to ensure continuity of service in the event of a line break or leak. The Putnam to Culloden Pipeline achieves this and improves system reliability through a two-way feed. This two-way feed pipeline allows additional gas to be put into the system and it also ensures that, in the event of a break or leak along this stretch of main, the flow of gas can be isolated at the leak and customers can be back-fed from the other direction, thereby minimizing impact to customers.

55. In terms of the Putnam to Culloden Pipeline facilitating future unsubsidized growth, the following points are salient:

    a. The line increased pressure in the Northeast quadrant near Brownsville such that ENGLP can safely and prudently add customers;

    b. There are approximately 69 existing residential and commercial customers that are receiving services by way of this line; and

    c. The line has the potential to connect approximately 250 future residential rate class customers in the South-West Oxford area.

56. In 2013-2015, both residential and commercial customers approached NRG to receive increased supply or to be connected to the distribution system. However, NRG lost

opportunities for commercial growth because it did not have sufficient gas volumes and pressures to meet this demand. Attached as Exhibit "**G**" to this Affidavit is correspondence from residents expressing interest in a natural gas connection in the Northeast quadrant.

57. NRG, and now ENGLP, felt compelled to participate in, and assist with, the economic and civic growth in the region. Accordingly, future growth was a secondary benefit considered in NRG's capital plan decision-making. Attached as Exhibit "**H**" to this Affidavit is a copy of a presentation delivered to Southwest Oxford by Brian Lippold regarding potential options to expand in response to requests for natural gas connections from prospective customers in the Northeast quadrant.

58. The Putnam to Culloden Pipeline, as noted above, facilitated a number of additional customer connections and the vast majority of connected customers are situated along the line or a distance from the line by way of an extension. These connections which include residential and high volume commercial and industrial customers. Attached as Exhibit "**I**" to this Affidavit is a map and chart which includes the noted line extensions. Furthermore, the following extensions from the Putnam to Culloden Pipeline which facilitated these customer connections were approved for inclusion into rate base in Phase 1 of the Application:

a. 2-inch Pipeline along Salford Road from Culloden Line to Dereham Line;

b. 2-inch Pipeline along Prouse Road, from Culloden Line to Dereham Line; and

c. 2-inch Pipeline along Dereham Line from Salford Road to Rouse Line.

59. As growth was a secondary consideration in implementing the line, a current Profitability Index (PI) is provided to demonstrate the project feasibility of the Putnam to Culloden Pipeline. The results of this analysis are attached as Exhibit "**I**" to this Affidavit is a summary of the PI analysis, which has been vetted to ensure that it does not contain proprietary or commercially sensitive information.

Efforts to Reduce Reliance on Locally Produced Premium Gas

60. At the time that the Four System Integrity Projects were implemented, NRG had assessed and determined that there were no other viable gas supplies in the south of the system aside from the NRG Corp. wells. Furthermore, the SNC Study illustrated what the utility already knew, which was that NRG Corp. wells were required to supply the Southeast quadrant for system integrity purposes.

61. The quantity of gas supplied by NRG Corp. represents under 2% of the total gas usage for the entire system and increasing volumes in the south through other sources would have had little to no impact on the dangerously low volume and pressure issues experienced in the Northeast quadrant.

62. NRG was mindful of the issue of premium priced local gas raised by the Board in the 2011 rates proceeding where the OEB expressed concern of NRG Corp.'s market power and the incremental cost to ratepayers for such premium gas.

63. In fact, NRG took the following concrete steps, with the goal of responding to the Board's concerns:

    a. In 2014, NRG made attempts to obtain additional gas from Union in the Southeast quadrant. NRG was not able to obtain gas in this area due to the high cost associated with reconfiguring the NRG system in the south to address the uptake of gas from small diameter lines and undersized valves and connections.

    b. In 2016 and 2017, NRG explored the possibility of trucking in compressed natural gas ("**CNG"**) for the south area of the system. This option was not viable because of the high cost of CNG, capital to receive CNG, and ongoing operational trucking costs.

    c. In 2017, NRG examined the potential to obtain additional well gas from areas outside of the system, also from wells located in Lake Eerie. At that time, the available options were cost prohibitive.

Prudency of the Putnam to Culloden Pipeline

64. When NRG developed and implemented the Putnam and Culloden Pipeline, NRG was under pressure to address dangerously low system pressures that posed a serious risk to public safety, employee safety and continuity of service to customers. It was not an option to leave this system integrity issue unresolved. Rather, addressing this system integrity issue drove management to aggressively pursue solutions to improve the movement of natural gas within the system.

65. NRG carefully and prudently analyzed its options with the aim of identifying the most viable, cost effective and expeditious solution. Throughout this process, NRG felt Union was being uncooperative. So NRG took the extreme step of filing a "failure to serve" application with the Board in November 2016, in a last ditch effort to secure additional gas volumes at reasonable pressures.

66. NRG was up against the clock to implement a solution in advance of the next heating season. Simply put, unnecessary or prolonged delays in implementing a solution were not acceptable to management.

67. The Four System Integrity Projects were set in motion when Union agreed to supply NRG with additional gas at the Bradley Station. This agreement was a significant change in circumstances that opened the door to a previously inaccessible, cost-effective solution that could be quickly implemented. Although these projects are not all connected, they work in harmony with one another to direct flows to low pressure areas of the system and also prevent the pulling of gas away from crucial areas. Therefore, each component was required and beneficial in targeting the concerning low system issues in the Southwest and Northeast quadrants of the distribution system.

68. In particular, the Putnam to Culloden Pipeline was determined to be the most crucial of the Four System Integrity Projects since the greatest risk arose from the dangerously low pressures in the Northeast quadrant near Brownsville. The Putnam to Culloden Pipeline sought to, and in fact did, alleviate low pressures in this area.

69. Furthermore, the Putnam to Culloden Pipeline is a used asset, currently serving numerous residential and commercial customers with the potential to meet the growing local demand for natural gas.

AFFIRMED BEFORE ME at London, Ontario, this 4th day of December, 2019.	
Commissioner for Oaths in and for the Province of Ontario	Brian Lippold

DANIEL S. J. BANGARTH
Barrister, Solicitor, Notary Public
562 Waterloo Street
London, Ontario N6B 2P9
Ph (519) 472 2340 | Fax (519) 657 8173

THIS IS EXHIBIT "A" REFERRED TO IN THE AFFIDAVIT OF BRIAN LIPPOLD SWORN ON DECEMBER 4, 2019.

Commissioner for Taking Affidavits

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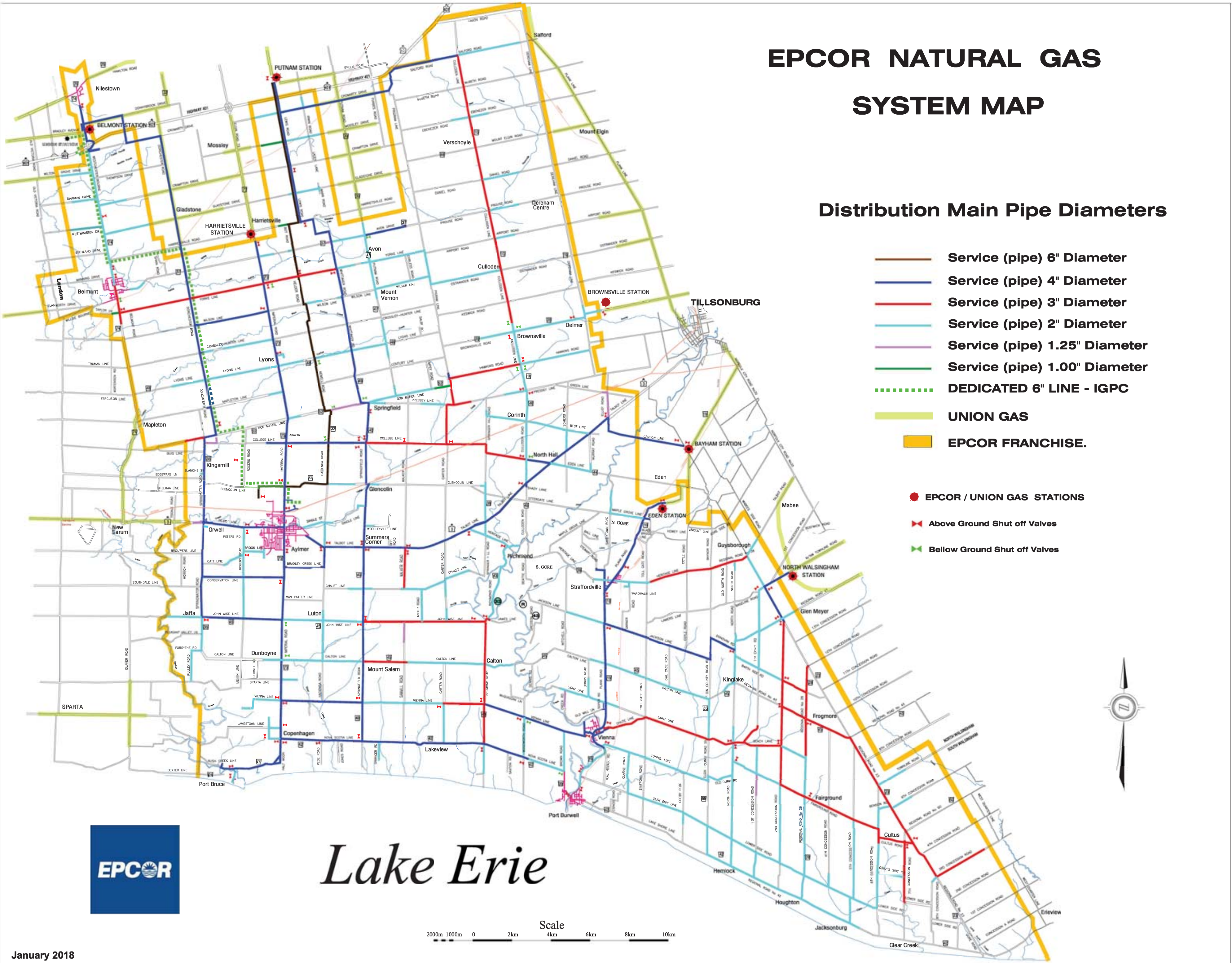
EPCOR NATURAL GAS SYSTEM MAP



January 2018

THIS IS EXHIBIT "B" REFERRED TO IN THE AFFIDAVIT OF BRIAN LIPPOLD SWORN ON DECEMBER 4, 2019.

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Commissioner for Taking Affidavits

DANIEL S. J. BANGARTH
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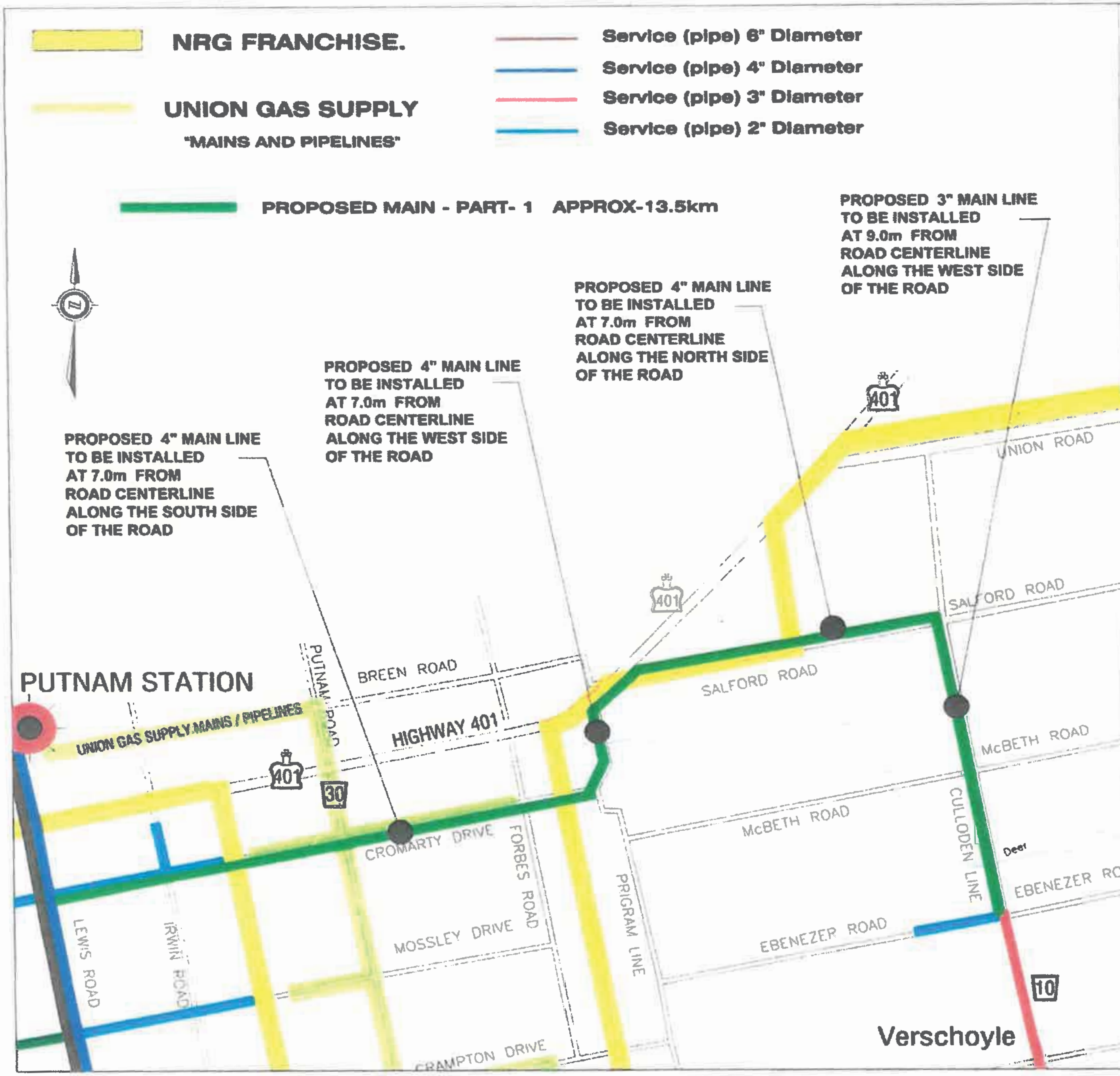


NOTES:

Pipe installations shall be carried out by plowing at a minimum depth of 0.8 m below existing grade elevations, unless otherwise noted.

Pipe crossings under all highways shall be carried out by directional drilling at a minimum depth of 1.2 m below ditch elevation.

Pipe crossings under all waterways and drainage shall be carried out by directional drilling as not to impact the existing watercourse.

Asphalt paved entrances shall be crossed using underground piercing tools at a minimum depth of 0.8 m.

No	REVISIONS	DATE	BY

Natural Resource Gas Limited

DESIGNED BY:	CHECKED BY:
DRAWN BY: T.B.	APPROVED BY:
PROJECT NAME: SW OXFORD 4" SUPPLY	

PIPELINE PROJECT
PHASE 1

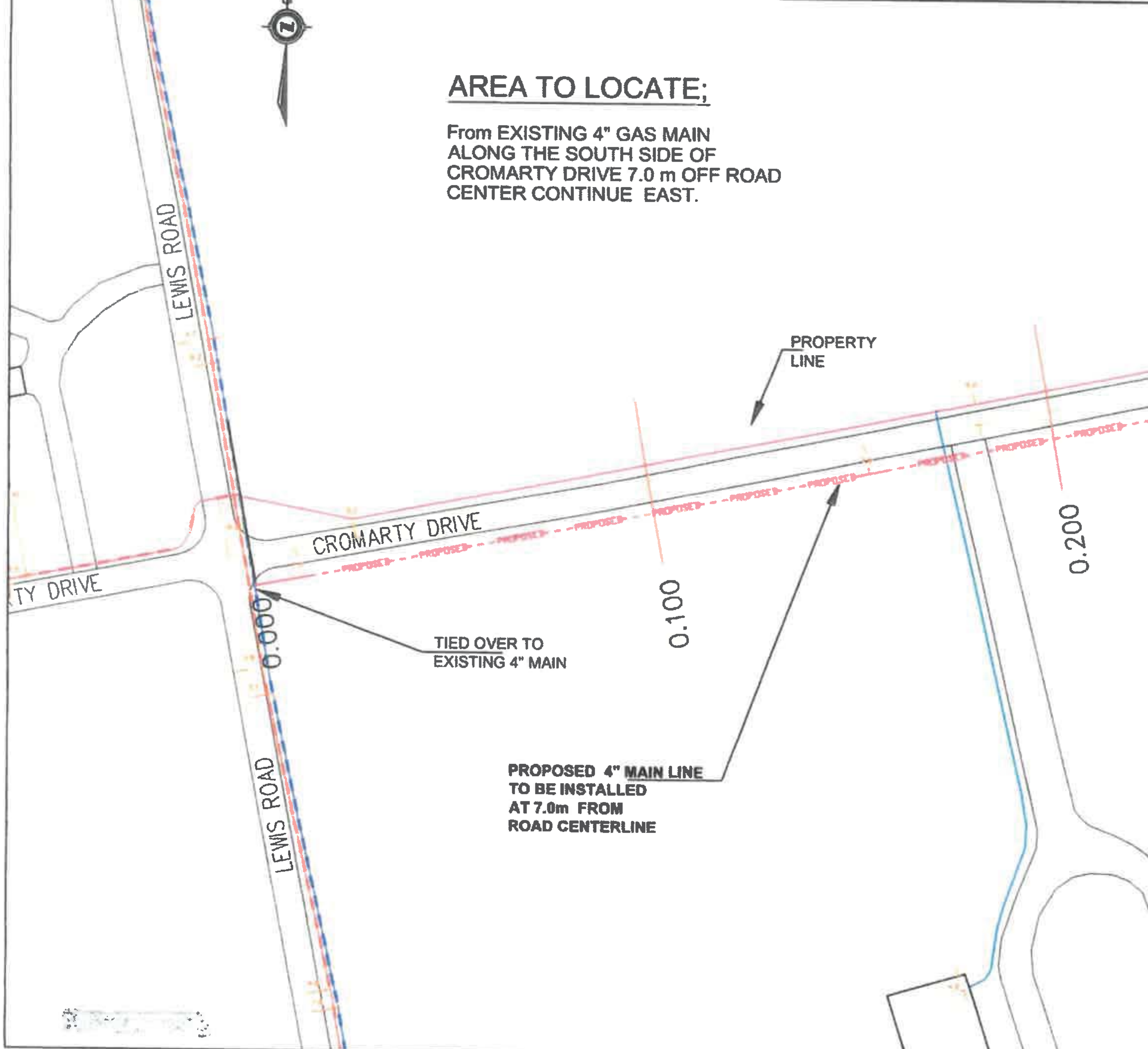
PROPOSED START DATE: 17/FEBRUARY/ 2016	
NODE No. XXX	DRAWING No 1 of 1

APPROVED BY ____________

DATE ____________

AREA TO LOCATE;

From EXISTING 4" GAS MAIN ALONG THE SOUTH SIDE OF CROMARTY DRIVE 7.0 m OFF ROAD CENTER CONTINUE EAST.



NOTES:

Pipe installations shall be carried out by plowing at a minimum depth of 0.8 m below existing grade elevations, unless otherwise noted.

Pipe crossings under all highways shall be carried out by directional drilling at a minimum depth of 1.2 m below ditch elevation.

Pipe crossings under all waterways and drainage shall be carried out by directional drilling as not to impact the existing watercourse.

Asphalt paved entrances shall be crossed using underground piercing tools at a minimum depth of 0.8 m.

No.	REVISIONS	DATE	BY

Natural Resource Gas Limited

DESIGNED BY:	CHECKED BY:
DRAWN BY: T.B.	APPROVED BY:
PROJECT NAME: SW OXFORD 4" SUPPLY	

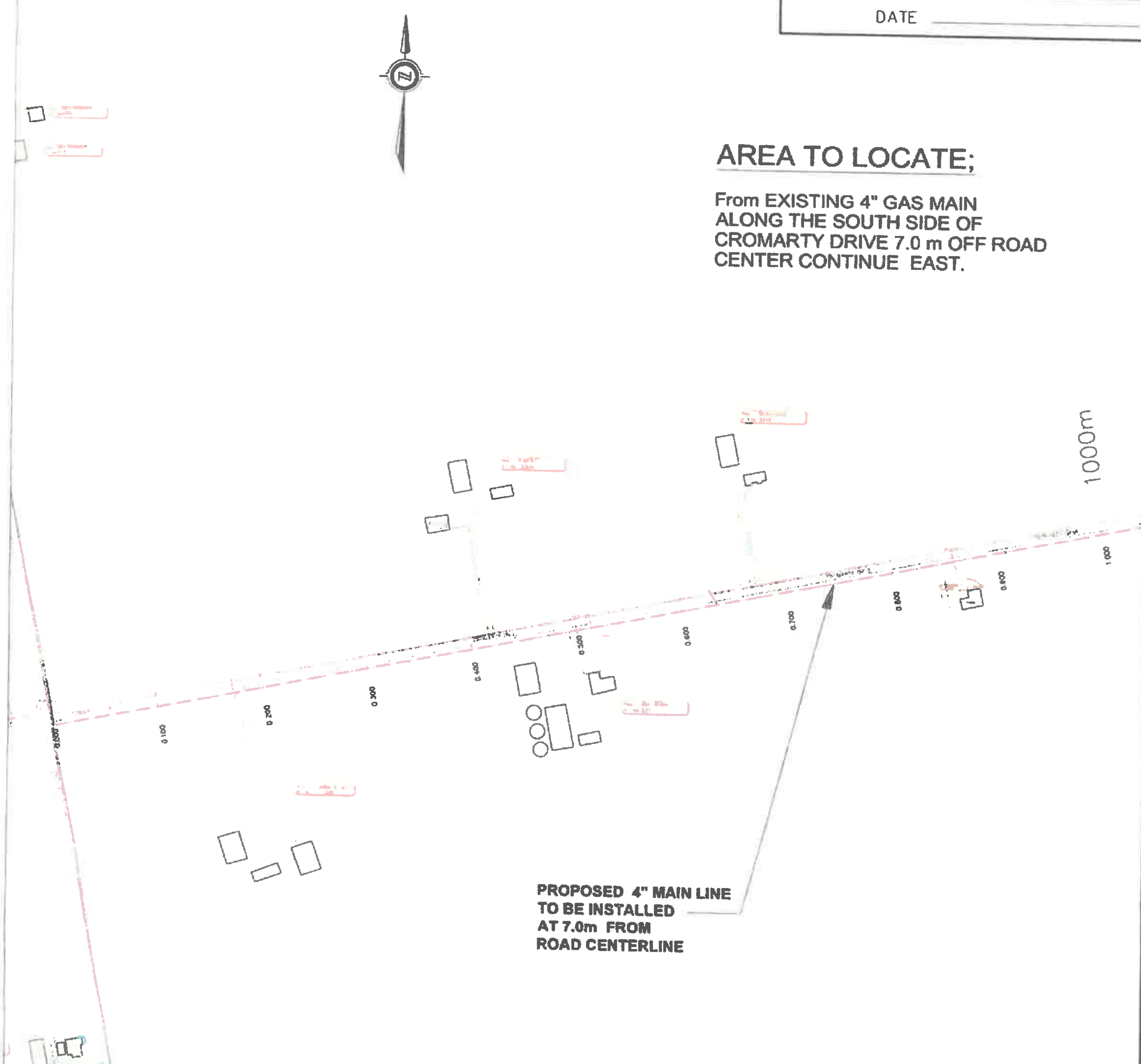
PIPELINE PROJECT

PHASE 1

PROPOSED START DATE: 17/FEBRUARY/ 2016	
NODE No. XXX	DRAWING No. 1 of 16

APPROVED BY ______

DATE ______



NOTES:

Pipe installations shall be carried out by plowing at a minimum depth of 0.8 m below existing grade elevations, unless otherwise noted.

Pipe crossings under all highways shall be carried out by directional drilling at a minimum depth of 1.2 m below ditch elevation.

Pipe crossings under all waterways and drainage shall be carried out by directional drilling as not to impact the existing watercourse.

Asphalt paved entrances shall be crossed using underground piercing tools at a minimum depth of 0.8 m.

No.	REVISIONS	DATE	BY

Natural Resource Gas Limited

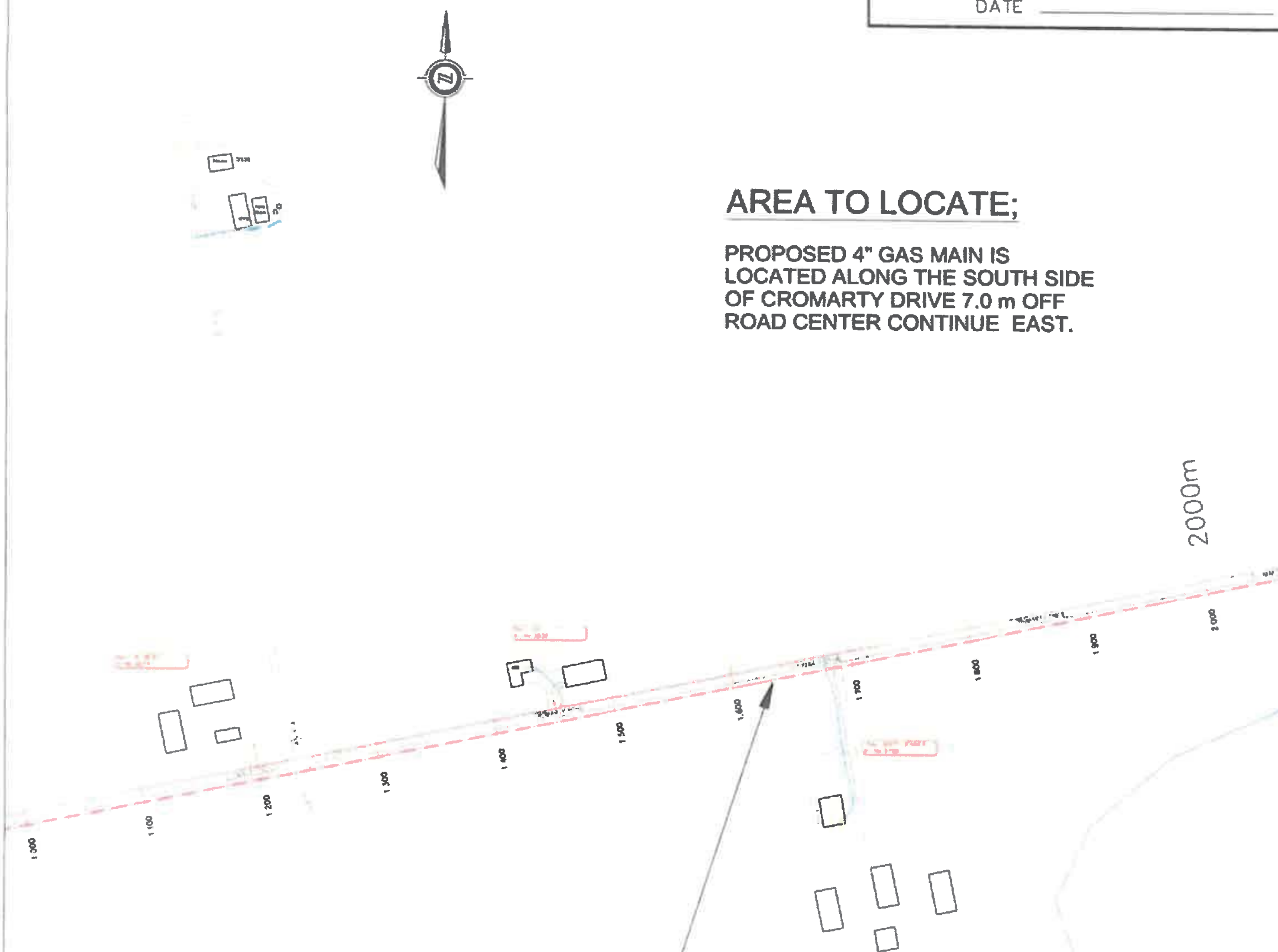
DESIGNED BY:	CHECKED BY:
DRAWN BY: T.B.	APPROVED BY:
PROJECT NAME: SW OXFORD 4" SUPPLY	

PIPELINE PROJECT

PHASE 1

PROPOSED START DATE: 17/FEBRUARY/ 2016	
NODE No. XXX	DRAWING No. 2 of 16

APPROVED BY	
DATE	



AREA TO LOCATE;

PROPOSED 4" GAS MAIN IS LOCATED ALONG THE SOUTH SIDE OF CROMARTY DRIVE 7.0 m OFF ROAD CENTER CONTINUE EAST.

PROPOSED 4" MAIN LINE TO BE INSTALLED AT 7.0m FROM ROAD CENTERLINE

NOTES:

Pipe installations shall be carried out by plowing at a minimum depth of 0.8 m below existing grade elevations, unless otherwise noted.

Pipe crossings under all highways shall be carried out by directional drilling at a minimum depth of 1.2 m below ditch elevation.

Pipe crossings under all waterways and drainage shall be carried out by directional drilling as not to impact the existing watercourse.

Asphalt paved entrances shall be crossed using underground piercing tools at a minimum depth of 0.8 m.

No.	REVISIONS	DATE	BY

Natural Resource Gas Limited

DESIGNED BY:	CHECKED BY
DRAWN BY: T.B.	APPROVED BY.
PROJECT NAME: SW OXFORD 4" SUPPLY	

PIPELINE PROJECT

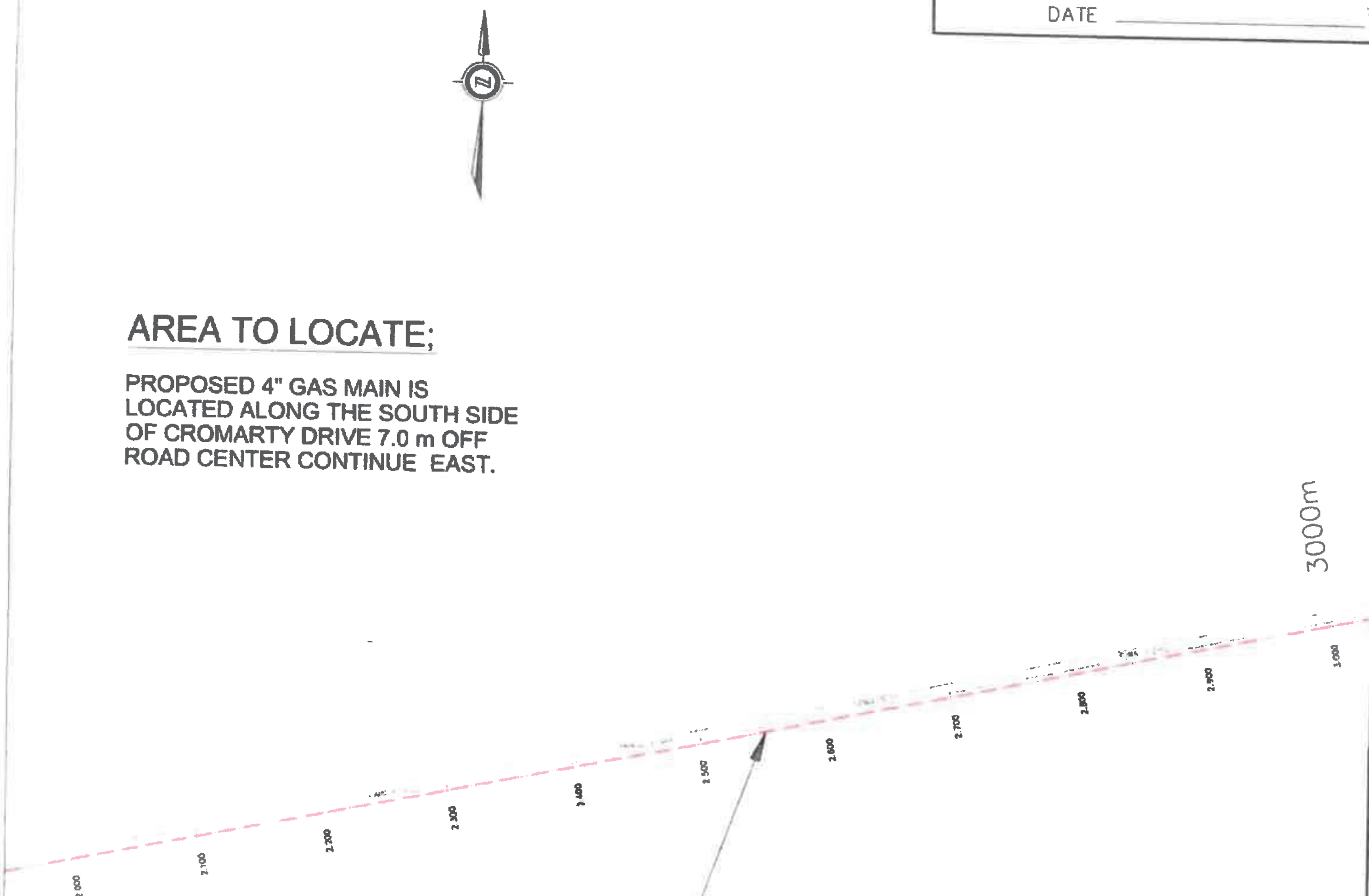
PHASE 1

PROPOSED START DATE: 17/FEBRUARY/ 2016	
NODE No. XXX	DRAWING No. 3 of 16

APPROVED BY	
DATE	

AREA TO LOCATE;

PROPOSED 4" GAS MAIN IS LOCATED ALONG THE SOUTH SIDE OF CROMARTY DRIVE 7.0 m OFF ROAD CENTER CONTINUE EAST.



PROPOSED 4" MAIN LINE TO BE INSTALLED AT 7.0m FROM ROAD CENTERLINE

NOTES:

Pipe installations shall be carried out by plowing at a minimum depth of 0.8 m below existing grade elevations, unless otherwise noted.

Pipe crossings under all highways shall be carried out by directional drilling at a minimum depth of 1.2 m below ditch elevation.

Pipe crossings under all waterways and drainage shall be carried out by directional drilling as not to impact the existing watercourse.

Asphalt paved entrances shall be crossed using underground piercing tools at a minimum depth of 0.8 m.

No.	REVISIONS	DATE	BY

Natural Resource Gas Limited

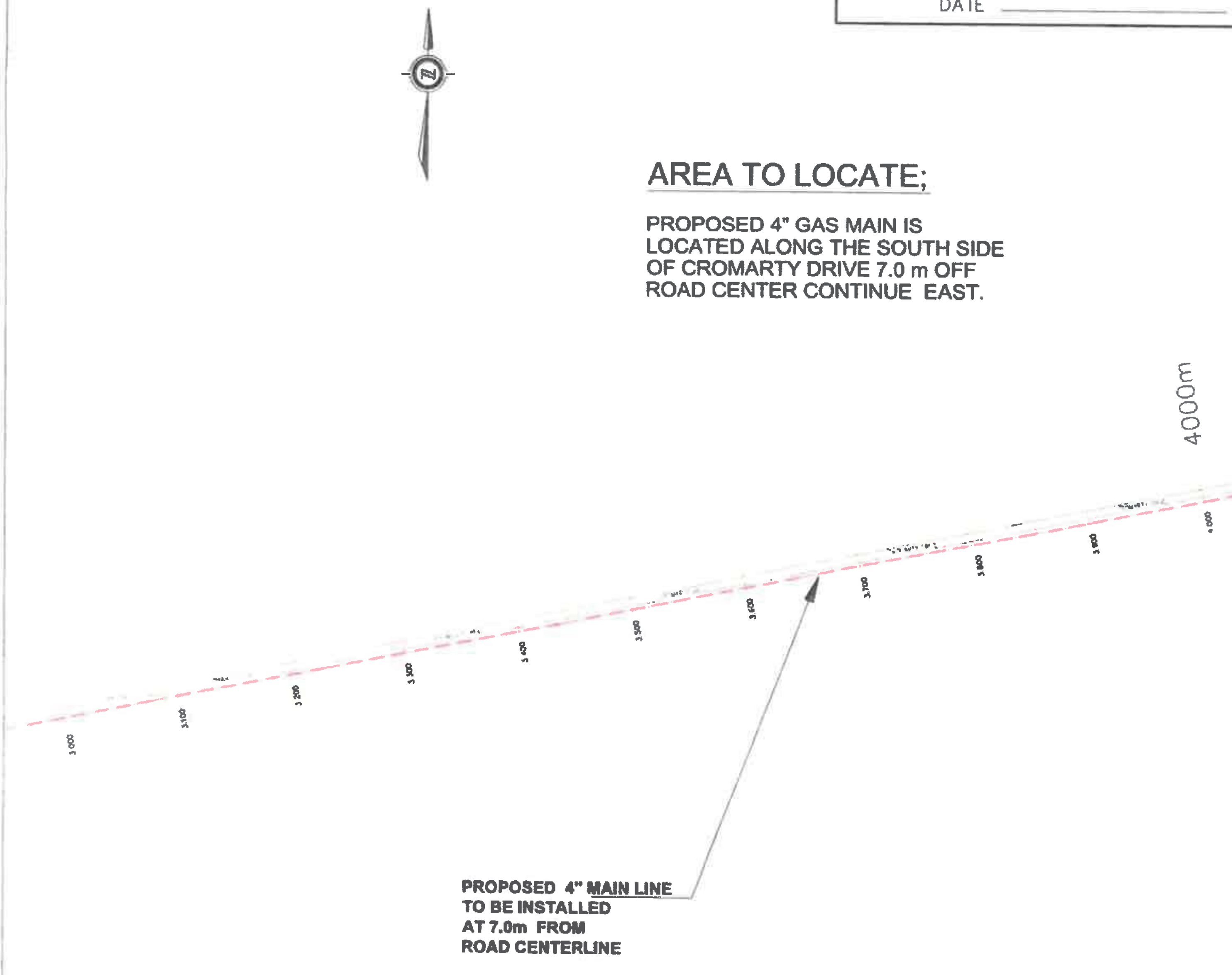
DESIGNED BY:		CHECKED BY:	
DRAWN BY:	T.B.	APPROVED BY:	
PROJECT NAME:	SW OXFORD 4" SUPPLY		

PIPELINE PROJECT

PHASE 1

PROPOSED START DATE:	17/FEBRUARY/ 2016		
NODE No.	XXX	DRAWING No.	4 of 16

APPROVED BY	
DATE	



NOTES:

Pipe installations shall be carried out by plowing at a minimum depth of 0.8 m below existing grade elevations, unless otherwise noted.

Pipe crossings under all highways shall be carried out by directional drilling at a minimum depth of 1.2 m below ditch elevation.

Pipe crossings under all waterways and drainage shall be carried out by directional drilling as not to impact the existing watercourse.

Asphalt paved entrances shall be crossed using underground piercing tools at a minimum depth of 0.8 m.

No.	REVISIONS	DATE	BY

Natural Resource Gas Limited

DESIGNED BY:	CHECKED BY:
DRAWN BY: T.B.	APPROVED BY:
PROJECT NAME: SW OXFORD 4" SUPPLY	

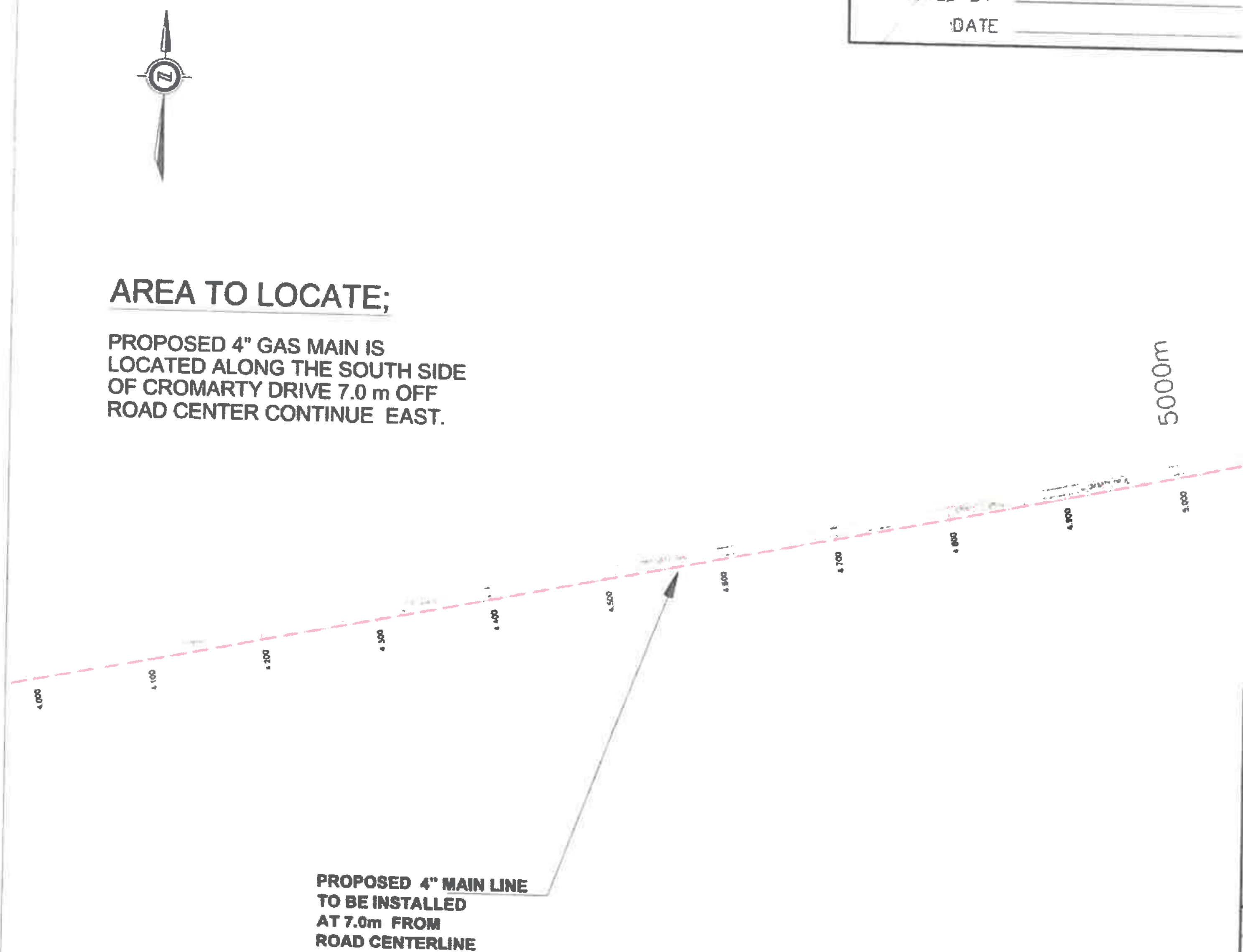
PIPELINE PROJECT

PHASE 1

PROPOSED START DATE: 17/FEBRUARY/ 2016	
NODE No. XXX	DRAWING No. 5 of 16

APPROVED BY ____________

DATE ____________



NOTES:

Pipe installations shall be carried out by plowing at a minimum depth of 0.8 m below existing grade elevations, unless otherwise noted.

Pipe crossings under all highways shall be carried out by directional drilling at a minimum depth of 1.2 m below ditch elevation.

Pipe crossings under all waterways and drainage shall be carried out by directional drilling as not to impact the existing watercourse.

Asphalt paved entrances shall be crossed using underground piercing tools at a minimum depth of 0.8 m.

No.	REVISIONS	DATE	BY

Natural Resource Gas Limited

DESIGNED BY:	CHECKED BY:
DRAWN BY: T.B.	APPROVED BY:
PROJECT NAME: SW OXFORD 4" SUPPLY	

PIPELINE PROJECT

PHASE 1

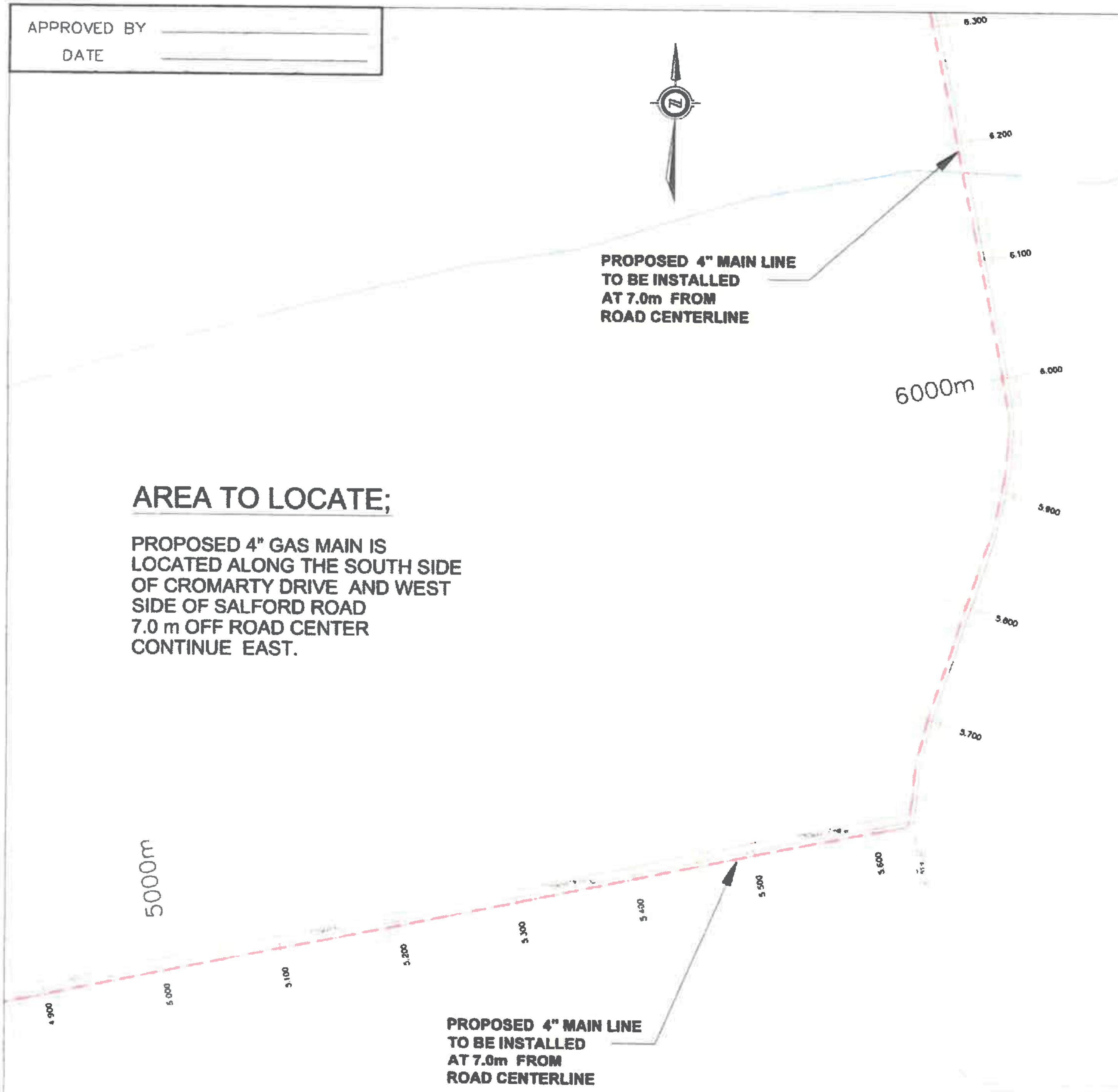
PROPOSED START DATE: 17/FEBRUARY/ 2016	
NODE No. XXX	DRAWING No. 6 of 16

APPROVED BY ______________

DATE ______________

AREA TO LOCATE;

PROPOSED 4" GAS MAIN IS LOCATED ALONG THE SOUTH SIDE OF CROMARTY DRIVE AND WEST SIDE OF SALFORD ROAD 7.0 m OFF ROAD CENTER CONTINUE EAST.



NOTES:

Pipe installations shall be carried out by plowing at a minimum depth of 0.8 m below existing grade elevations, unless otherwise noted.

Pipe crossings under all highways shall be carried out by directional drilling at a minimum depth of 1.2 m below ditch elevation.

Pipe crossings under all waterways and drainage shall be carried out by directional drilling as not to impact the existing watercourse.

Asphalt paved entrances shall be crossed using underground piercing tools at a minimum depth of 0.8 m.

No.	REVISIONS	DATE	BY

Natural Resource Gas Limited

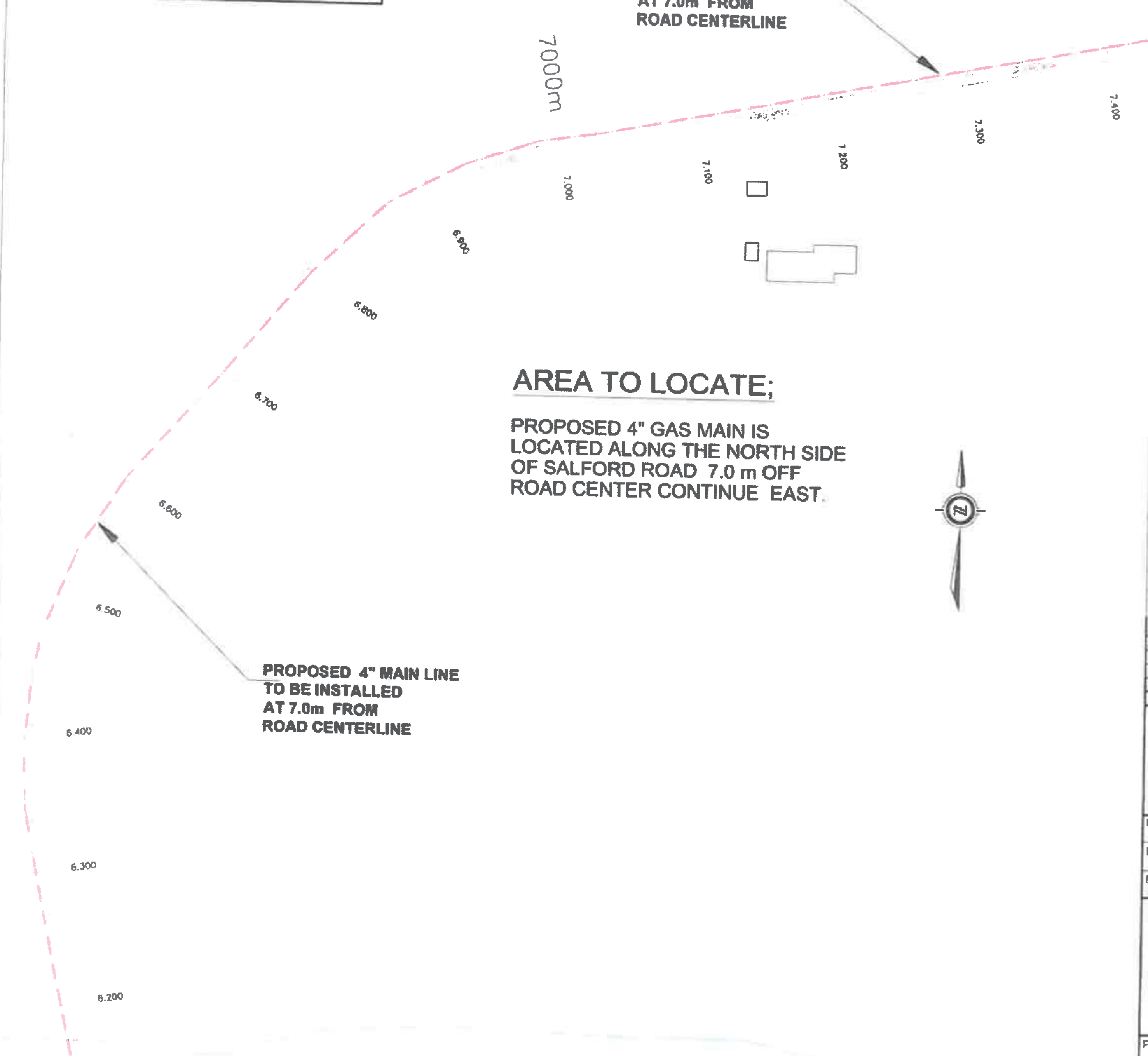
DESIGNED BY:	CHECKED BY:
DRAWN BY: T.B.	APPROVED BY:
PROJECT NAME: SW OXFORD 4" SUPPLY	

PIPELINE PROJECT

PHASE 1

PROPOSED START DATE: 17/FEBRUARY/ 2016	
NODE No. XXX	DRAWING No 7 of 16

APPROVED BY ______
DATE ______



NOTES:

Pipe installations shall be carried out by plowing at a minimum depth of 0.8 m below existing grade elevations, unless otherwise noted.

Pipe crossings under all highways shall be carried out by directional drilling at a minimum depth of 1.2 m below ditch elevation.

Pipe crossings under all waterways and drainage shall be carried out by directional drilling as not to impact the existing watercourse.

Asphalt paved entrances shall be crossed using underground piercing tools at a minimum depth of 0.8 m.

No.	REVISIONS	DATE	BY

Natural Resource Gas Limited

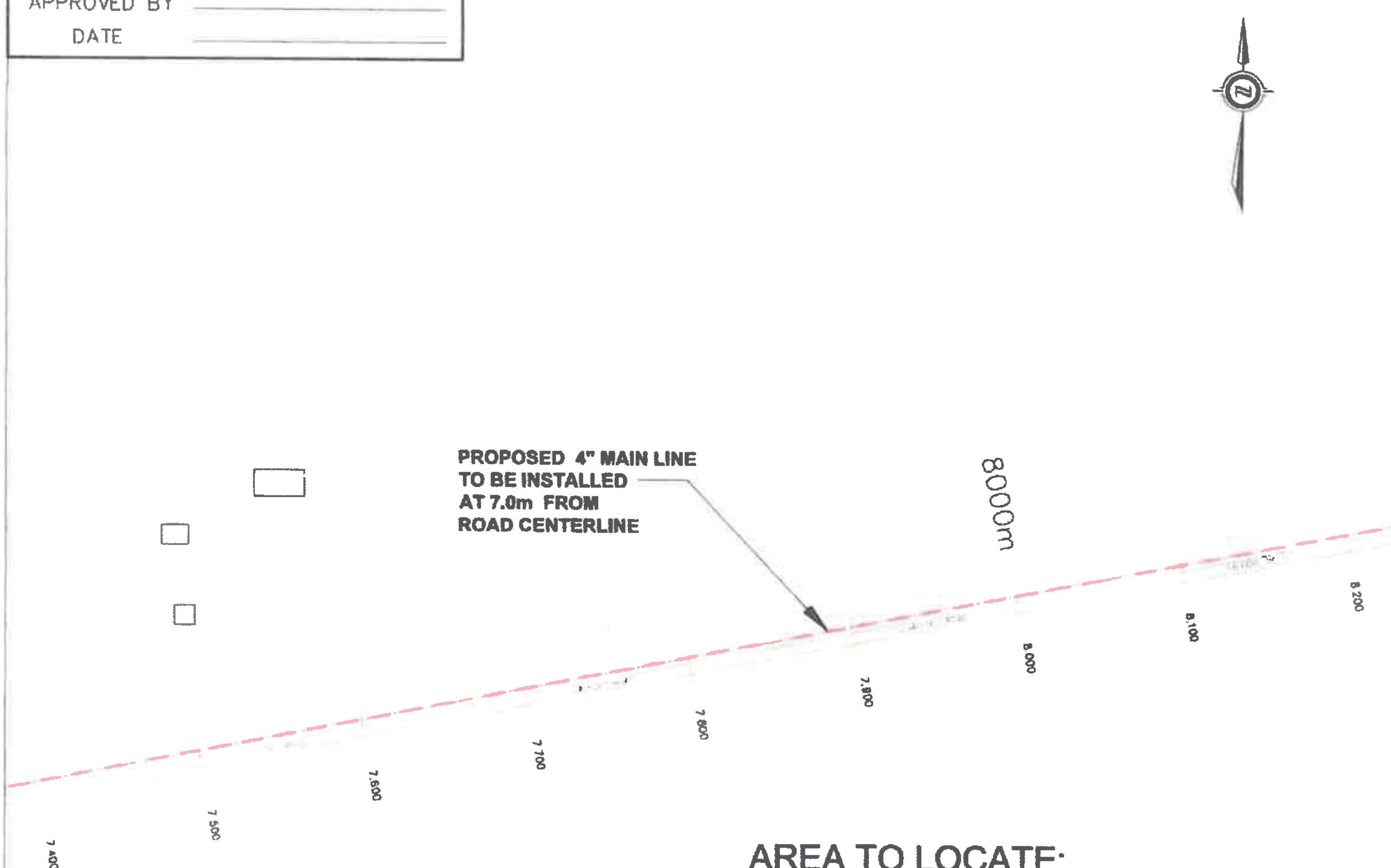
DESIGNED BY:	CHECKED BY:
DRAWN BY: T.B.	APPROVED BY:
PROJECT NAME: SW OXFORD 4" SUPPLY	

PIPELINE PROJECT
PHASE 1

PROPOSED START DATE: 17/FEBRUARY/ 2016	
NODE No XXX	DRAWING No. 8 of 16

APPROVED BY

DATE



AREA TO LOCATE;

PROPOSED 4" GAS MAIN IS LOCATED ALONG THE NORTH SIDE OF SALFORD ROAD 7.0 m OFF ROAD CENTER CONTINUE EAST.

NOTES:

Pipe installations shall be carried out by plowing at a minimum depth of 0.8 m below existing grade elevations, unless otherwise noted.

Pipe crossings under all highways shall be carried out by directional drilling at a minimum depth of 1.2 m below ditch elevation.

Pipe crossings under all waterways and drainage shall be carried out by directional drilling as not to impact the existing watercourse.

Asphalt paved entrances shall be crossed using underground piercing tools at a minimum depth of 0.8 m.

No.	REVISIONS	DATE	BY

NRG Natural Resource Gas Limited

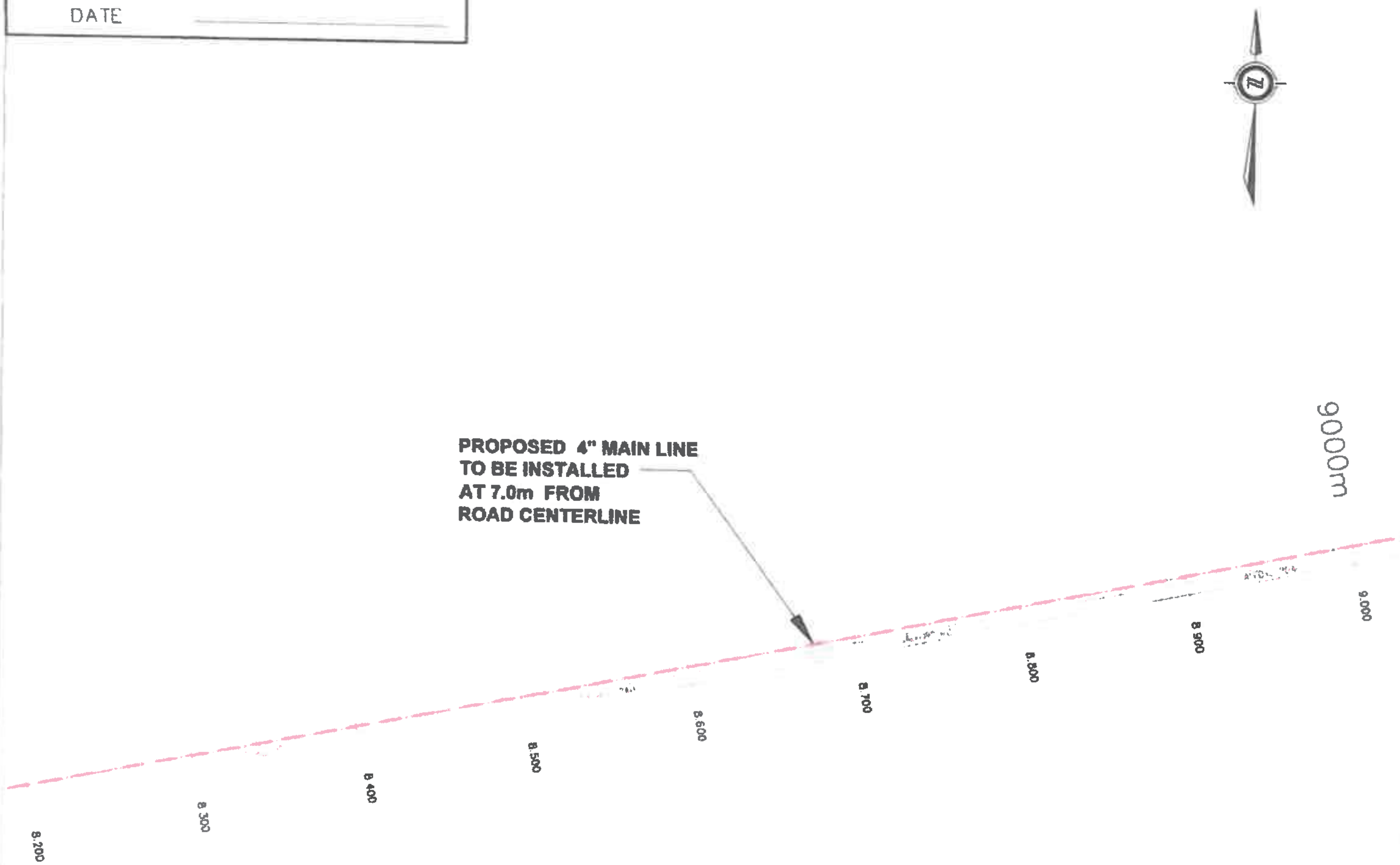
DESIGNED BY:	CHECKED BY:
DRAWN BY: T.B.	APPROVED BY:
PROJECT NAME: SW OXFORD 4" SUPPLY	

PIPELINE PROJECT

PHASE 1

PROPOSED START DATE: 17/FEBRUARY/ 2016	
NODE No. XXX	DRAWING No. 9 of 16

APPROVED BY	
DATE	



AREA TO LOCATE;

PROPOSED 4" GAS MAIN IS LOCATED ALONG THE NORTH SIDE OF SALFORD ROAD 7.0 m OFF ROAD CENTER CONTINUE EAST.

NOTES:

Pipe installations shall be carried out by plowing at a minimum depth of 0.8 m below existing grade elevations, unless otherwise noted.

Pipe crossings under all highways shall be carried out by directional drilling at a minimum depth of 1.2 m below ditch elevation.

Pipe crossings under all waterways and drainage shall be carried out by directional drilling as not to impact the existing watercourse.

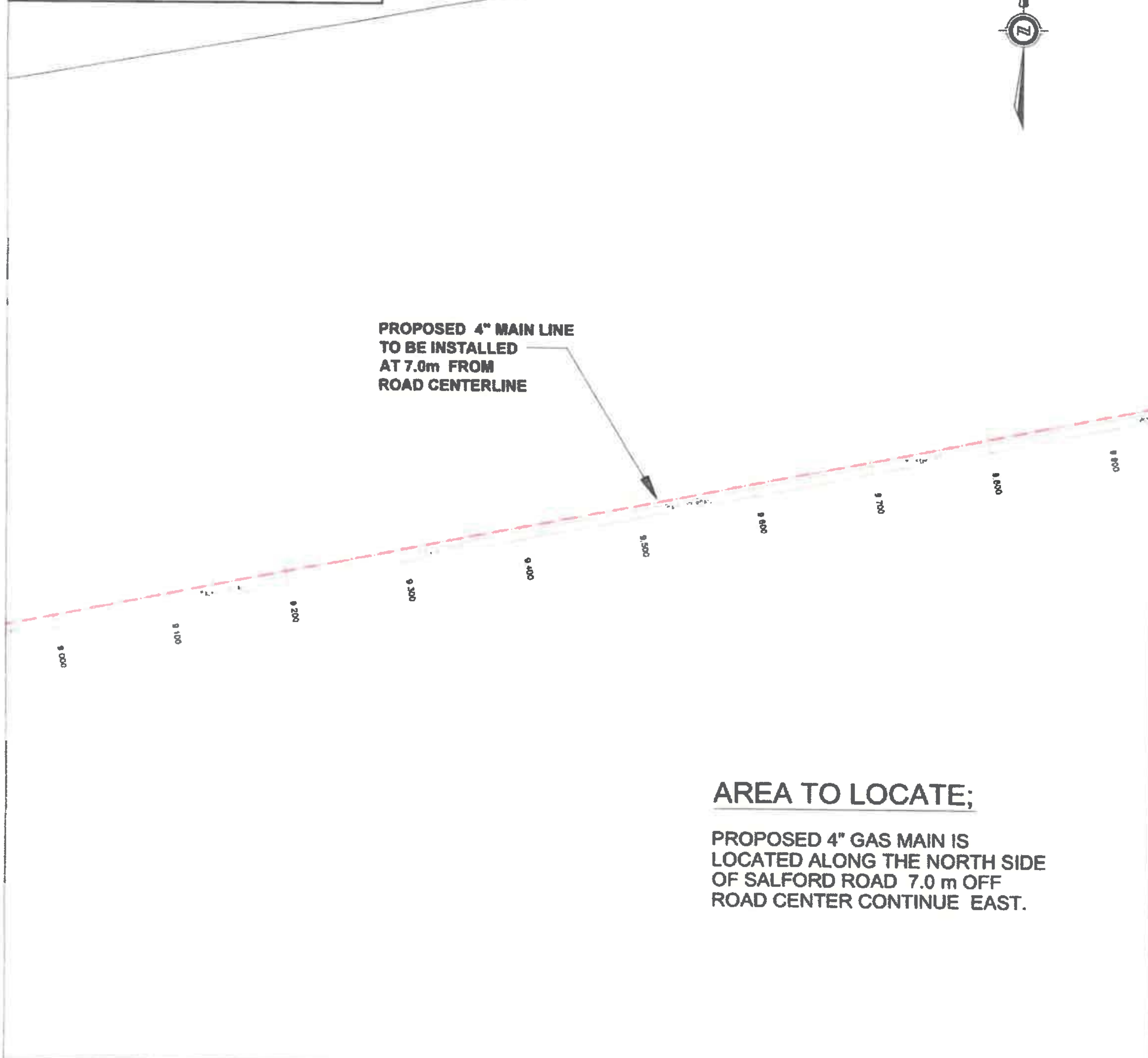
Asphalt paved entrances shall be crossed using underground piercing tools at a minimum depth of 0.8 m.

No	REVISIONS	DATE	BY

Natural Resource Gas Limited

DESIGNED BY:	CHECKED BY:
DRAWN BY: T.B.	APPROVED BY:
PROJECT NAME: SW OXFORD 4" SUPPLY	
PIPELINE PROJECT PHASE 1	
PROPOSED START DATE: 17/FEBRUARY/ 2016	
NODE No. XXX	DRAWING No. 10 of 16

APPROVED BY
DATE



AREA TO LOCATE;

PROPOSED 4" GAS MAIN IS LOCATED ALONG THE NORTH SIDE OF SALFORD ROAD 7.0 m OFF ROAD CENTER CONTINUE EAST.

NOTES:

Pipe installations shall be carried out by plowing at a minimum depth of 0.8 m below existing grade elevations, unless otherwise noted.

Pipe crossings under all highways shall be carried out by directional drilling at a minimum depth of 1.2 m below ditch elevation.

Pipe crossings under all waterways and drainage shall be carried out by directional drilling as not to impact the existing watercourse.

Asphalt paved entrances shall be crossed using underground piercing tools at a minimum depth of 0.8 m.

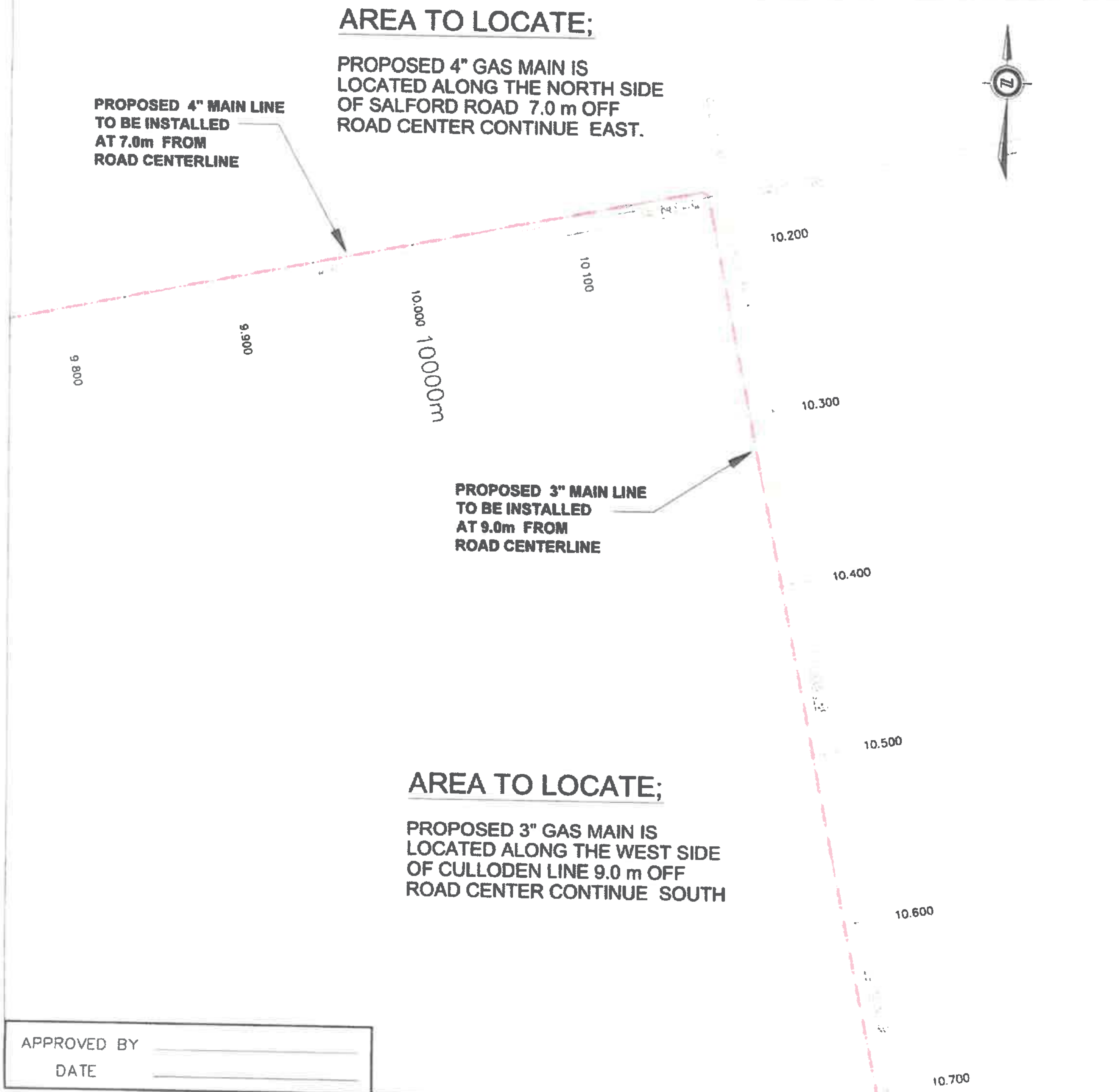
No.	REVISIONS	DATE	BY

Natural Resource Gas Limited

DESIGNED BY:	CHECKED BY:
DRAWN BY: T.B.	APPROVED BY:
PROJECT NAME: SW OXFORD 4" SUPPLY	

PIPELINE PROJECT
PHASE 1

PROPOSED START DATE: 17/FEBRUARY/ 2016	
NODE No. XXX	DRAWING No. 11 of 16



NOTES:

Pipe installations shall be carried out by plowing at a minimum depth of 0.8 m below existing grade elevations, unless otherwise noted.

Pipe crossings under all highways shall be carried out by directional drilling at a minimum depth of 1.2 m below ditch elevation.

Pipe crossings under all waterways and drainage shall be carried out by directional drilling as not to impact the existing watercourse.

Asphalt paved entrances shall be crossed using underground piercing tools at a minimum depth of 0.8 m.

No.	REVISIONS	DATE	BY

Natural Resource Gas Limited

DESIGNED BY:	CHECKED BY:
DRAWN BY: T.B.	APPROVED BY:
PROJECT NAME: SW OXFORD 4" SUPPLY	

PIPELINE PROJECT

PHASE 1

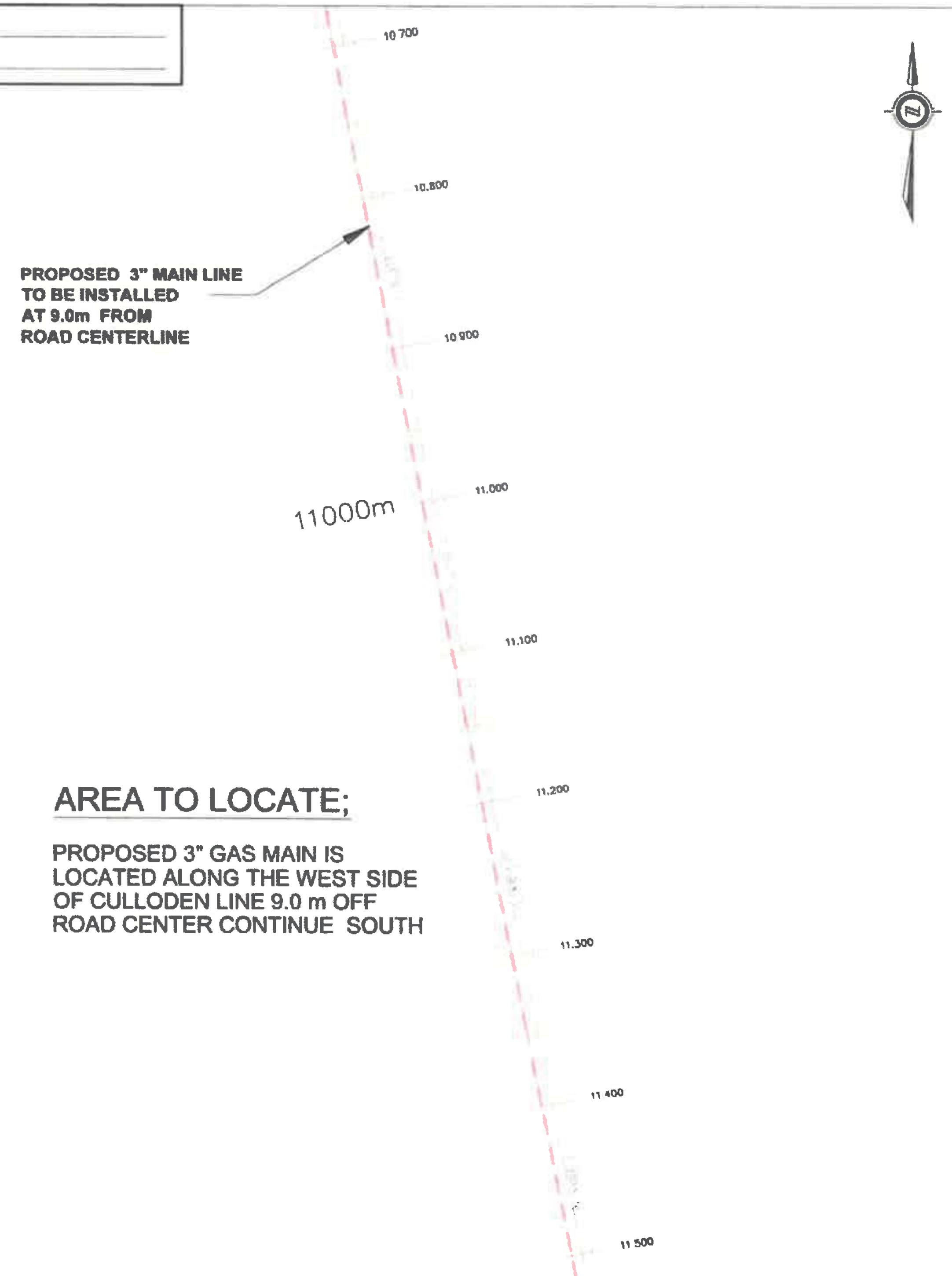
PROPOSED START DATE: 17/FEBRUARY/ 2016	
NODE No. XXX	DRAWING No. 12 of 16

APPROVED BY ____________

DATE ____________

APPROVED BY ______

DATE ______



AREA TO LOCATE;

PROPOSED 3" GAS MAIN IS LOCATED ALONG THE WEST SIDE OF CULLODEN LINE 9.0 m OFF ROAD CENTER CONTINUE SOUTH

NOTES:

Pipe installations shall be carried out by plowing at a minimum depth of 0.8 m below existing grade elevations, unless otherwise noted.

Pipe crossings under all highways shall be carried out by directional drilling at a minimum depth of 1.2 m below ditch elevation.

Pipe crossings under all waterways and drainage shall be carried out by directional drilling as not to impact the existing watercourse.

Asphalt paved entrances shall be crossed using underground piercing tools at a minimum depth of 0.8 m.

No.	REVISIONS	DATE	BY

Natural Resource Gas Limited

DESIGNED BY:	CHECKED BY:
DRAWN BY: T.B.	APPROVED BY:
PROJECT NAME: SW OXFORD 4" SUPPLY	

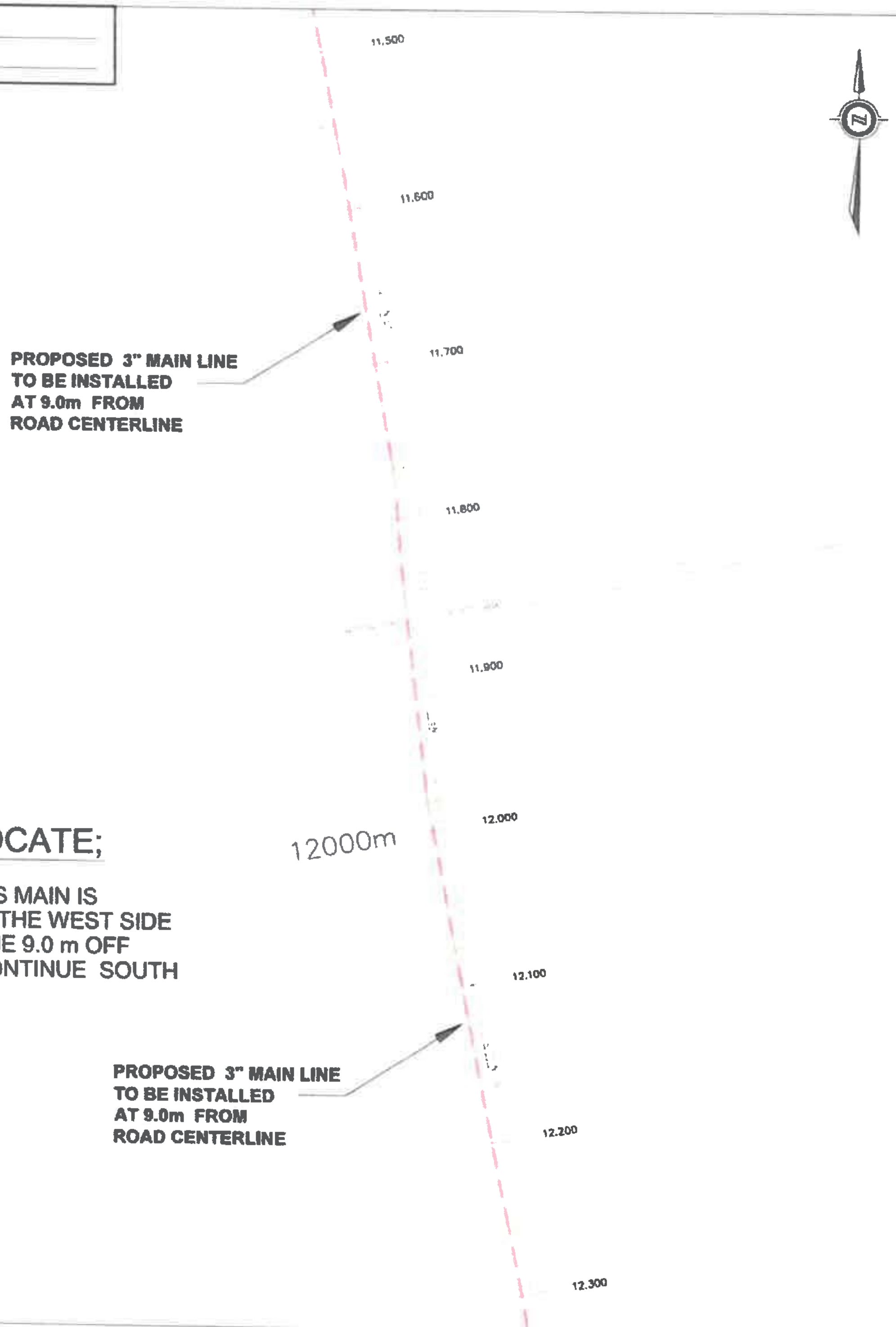
PIPELINE PROJECT

PHASE 1

PROPOSED START DATE: 17/FEBRUARY/ 2016	
NODE No. XXX	DRAWING No. 13 of 16

APPROVED BY ______________

DATE ______________



AREA TO LOCATE;

PROPOSED 3" GAS MAIN IS LOCATED ALONG THE WEST SIDE OF CULLODEN LINE 9.0 m OFF ROAD CENTER CONTINUE SOUTH

NOTES:

Pipe installations shall be carried out by plowing at a minimum depth of 0.8 m below existing grade elevations, unless otherwise noted.

Pipe crossings under all highways shall be carried out by directional drilling at a minimum depth of 1.2 m below ditch elevation.

Pipe crossings under all waterways and drainage shall be carried out by directional drilling as not to impact the existing watercourse.

Asphalt paved entrances shall be crossed using underground piercing tools at a minimum depth of 0.8 m.

No.	REVISIONS	DATE	BY

NRG Natural Resource Gas Limited

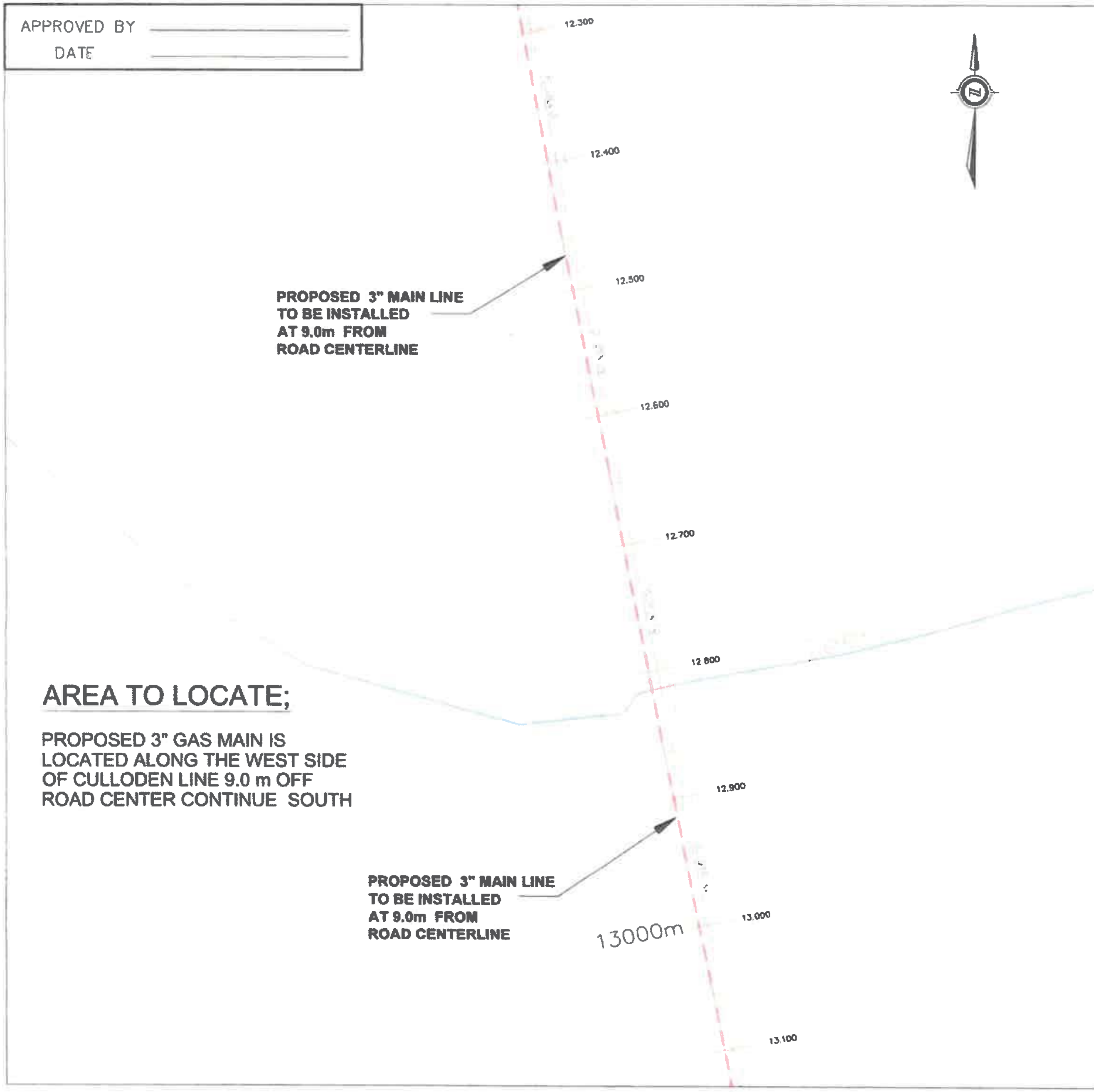
DESIGNED BY:		CHECKED BY:	
DRAWN BY:	T.B.	APPROVED BY:	
PROJECT NAME:	SW OXFORD 4" SUPPLY		

PIPELINE PROJECT

PHASE 1

PROPOSED START DATE:	17/FEBRUARY/ 2016		
NODE No.	XXX	DRAWING No.	14 of 16

APPROVED BY	
DATE	



NOTES:

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Pipe crossings under all waterways and drainage shall be carried out by directional drilling as not to impact the existing watercourse.

Asphalt paved entrances shall be crossed using underground piercing tools at a minimum depth of 0.8 m.

No.	REVISIONS	DATE	BY

Natural Resource Gas Limited

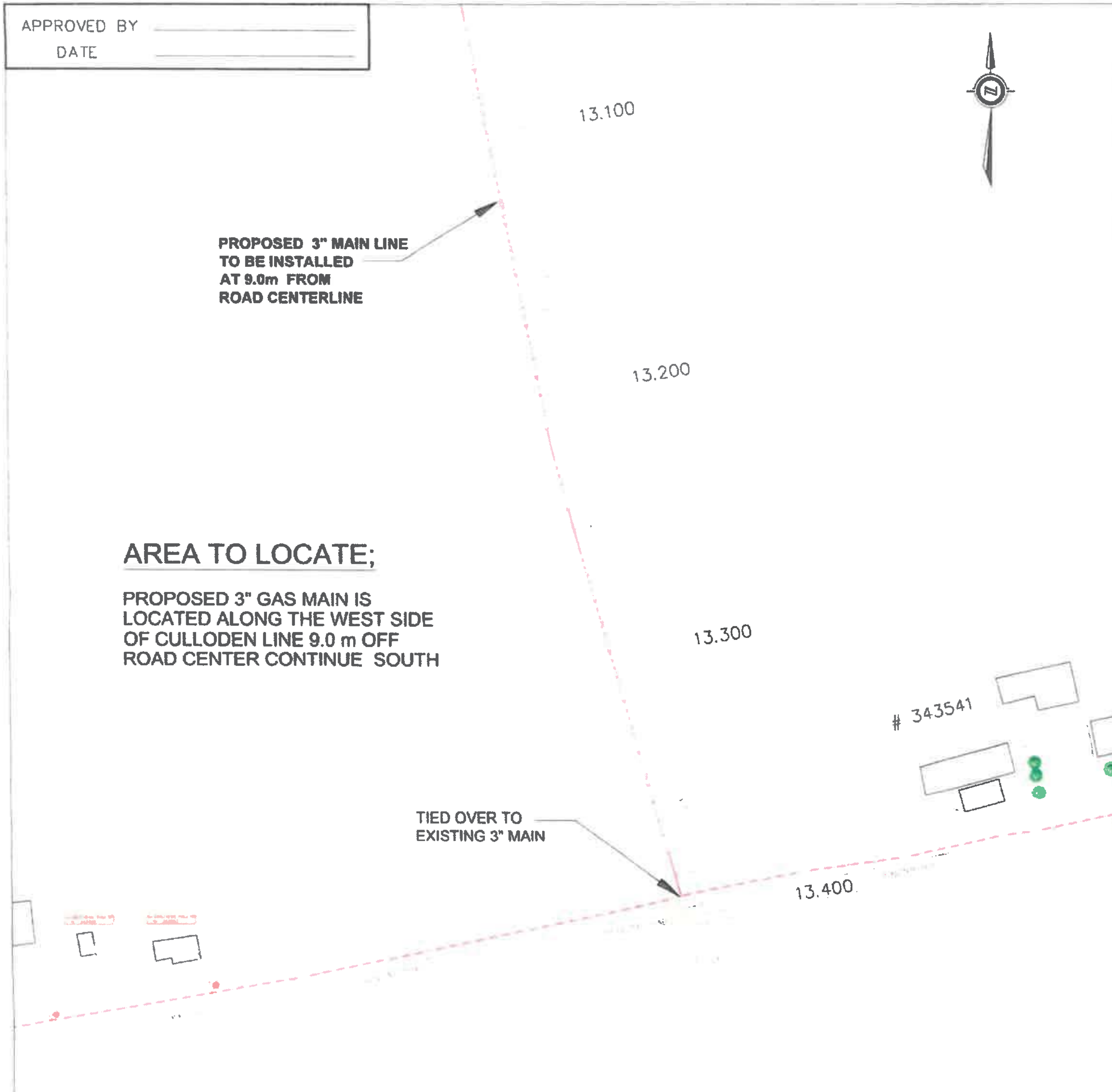
DESIGNED BY:	CHECKED BY:
DRAWN BY: T.B.	APPROVED BY:
PROJECT NAME: SW OXFORD 4" SUPPLY	

PIPELINE PROJECT

PHASE 1

PROPOSED START DATE: 17/FEBRUARY/ 2016	
NODE No. XXX	DRAWING No. 15 of 16

APPROVED BY	
DATE	



AREA TO LOCATE;

PROPOSED 3" GAS MAIN IS LOCATED ALONG THE WEST SIDE OF CULLODEN LINE 9.0 m OFF ROAD CENTER CONTINUE SOUTH

NOTES:

Pipe installations shall be carried out by plowing at a minimum depth of 0.8 m below existing grade elevations, unless otherwise noted.

Pipe crossings under all highways shall be carried out by directional drilling at a minimum depth of 1.2 m below ditch elevation.

Pipe crossings under all waterways and drainage shall be carried out by directional drilling as not to impact the existing watercourse.

Asphalt paved entrances shall be crossed using underground piercing tools at a minimum depth of 0.8 m.

No.	REVISIONS	DATE	BY

Natural Resource Gas Limited

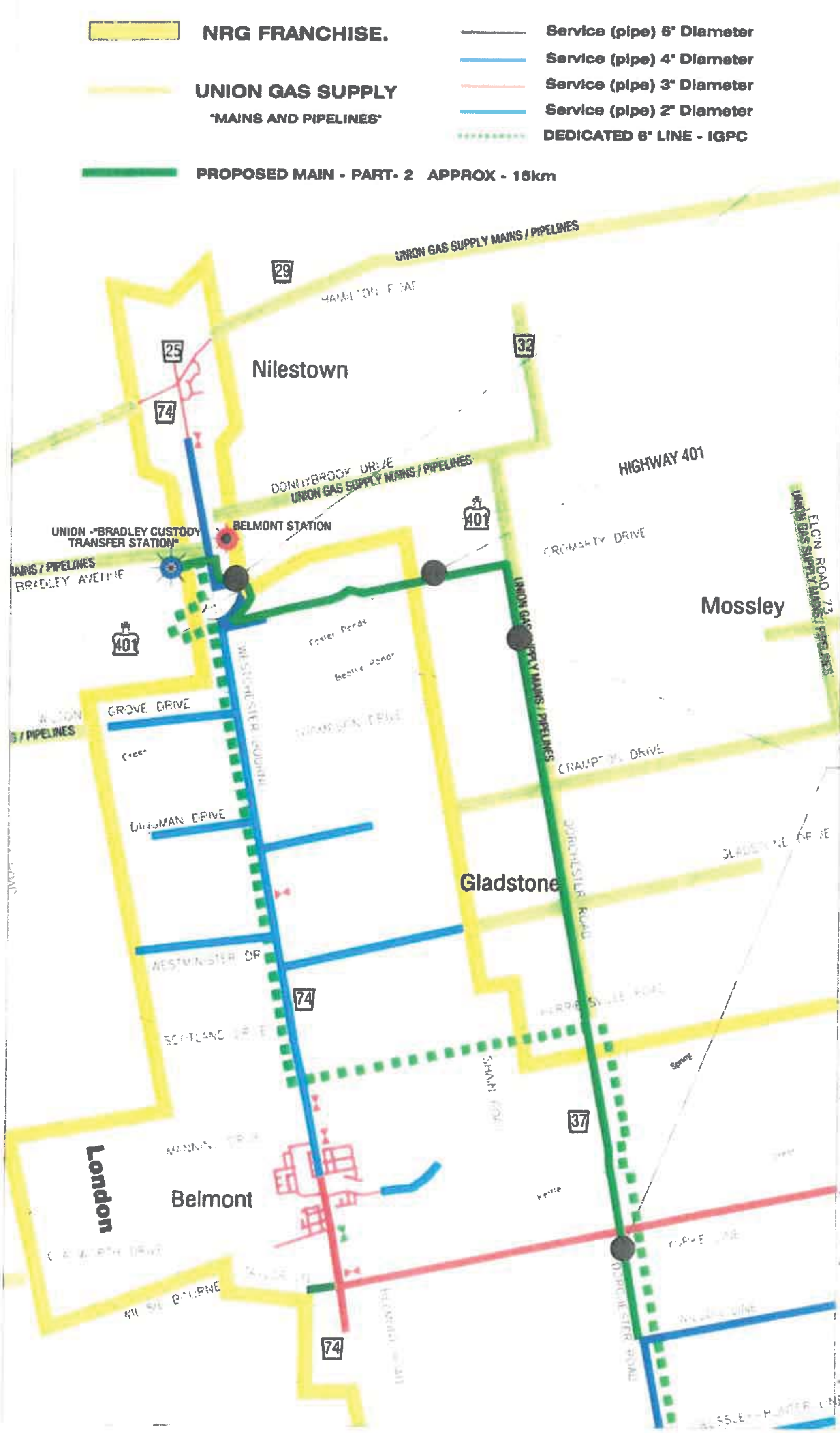
DESIGNED BY:		CHECKED BY:	
DRAWN BY:	T.B.	APPROVED BY:	
PROJECT NAME:	SW OXFORD 4" SUPPLY		

PIPELINE PROJECT

PHASE 1

PROPOSED START DATE:	17/FEBRUARY/ 2016		
NODE No.	XXX	DRAWING No.	16 of 16

[redacted] [redacted]

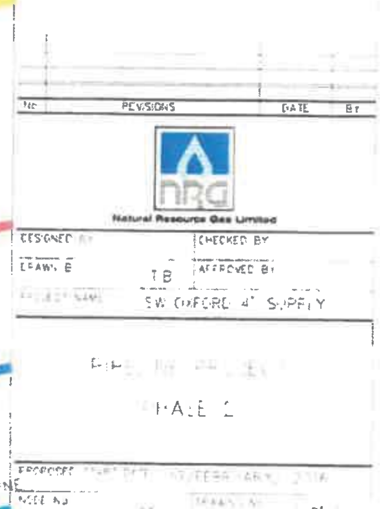


PROPOSED 4" MAIN LINE TO BE INSTALLED FROM NRG/UNION GAS COMPOUND ON THE SW CORNER OF BRADLEY AVE. AND WESTCHESTER BOURNE.

EAST ACROSS WESTCHESTER BOURNE CONTINUE SOUTH TO CROMARTY DRIVE ON THE EAST SIDE OF WESTCHESTER BOURNE 1m OFF PROPERTY LINE AND AROUND THE 401 INTERCHANGE AS THE MAP SHOWS.

PROPOSED 4" MAIN LINE TO CONTINUE EAST ON CROMARTY DR. ON THE NORTH SIDE OF THE ROAD. 1-2m OFF THE EDGE OF THE ROAD. CONTINUE ALL THE WAY TO DORCHESTER ROAD.

PROPOSED 4" MAIN LINE TO CONTINUE SOUTH ON DORCHESTER ROAD ALL THE WAY TO WILSON LINE ON THE WEST SIDE OF THE ROAD 1m OFF THE EDGE OF THE ROAD



THIS IS EXHIBIT "C" REFERRED TO IN THE AFFIDAVIT OF BRIAN LIPPOLD SWORN ON DECEMBER 4, 2019.

Commissioner for Taking Affidavits

DANIEL S. J. BANGARTH
Barrister, Solicitor, Notary Public
562 Waterloo Street
London, Ontario N6B 2P9
Ph (519) 472 2340 | Fax (519) 657 8173

SNC·LAVALIN OIL & GAS BUSINESS UNIT	NATURAL RESOURCE GAS LIMITED Transient Simulations of the NRG Distribution System Report	Page 1 of 34 Revision No.: A
		Date: March, 2016

INSTRUCTION TO DOCUMENT CONTROL

- [ ] Entire specification revised. Reissue all pages.
- [ ] Reissue revised pages only.

STAMP THE SPECIFICATION AS FOLLOWS:

- [X] Issued for review and comments
- [ ] Issued for quotation
- [ ] Issued for purchase
- [ ] Issued for fabrication (equipment specs only)
- [ ] Issued for construction (installation specs only)
- [ ] Issued for design

TECHNICAL REPORT REVISION INDEX

Revision					Pages Revised	Remarks
No.	Prepared By/ Date	Checked By/ Date	Project Approved/ Date	Client Approved/ Date		
A	John Orr Mar. 2016	Alex Huddleston Mar, 2016	Alex Huddleston Mar, 2016			

TABLE OF CONTENTS

NOTICE

This document contains the expression of the professional opinion of SNC-Lavalin Inc. ("SNC-Lavalin") as to the matters set out herein, using its professional judgment and reasonable care. It is to be read in the context of the Services Agreement Dated May 22, 2014 (the "Agreement") between SNC-Lavalin and Natural Gas Resources Limited (the "Company"), and the methodology, procedures and techniques used, SNC-Lavalin's assumptions, and the circumstances and constraints under which its mandate was performed. This document is written solely for the purpose stated in the Agreement, and for the sole and exclusive benefit of the Company, whose remedies are limited to those set out in the Agreement. This document is meant to be read as a whole, and sections or parts thereof should thus not be read or relied upon out of context.

SNC-Lavalin has, in preparing this report, followed methodology and procedures, and exercised due care consistent with the intended level of accuracy, using its professional judgment and reasonable care. Unless expressly stated otherwise, assumptions, data and information supplied by, or gathered from other sources (including the Company, other contractors, testing laboratories and equipment suppliers, etc.) upon which SNC-Lavalin's opinion as set out herein is based has not been verified by SNC-Lavalin; SNC-Lavalin makes no representation as to its accuracy and disclaims all liability with respect thereto.

SNC-Lavalin disclaims any liability to the Company and to third parties in respect of the publication, reference, quoting, or distribution of this report or any of its contents to and reliance thereon by any third party.

1. INTRODUCTION

Natural Resource Gas Limited (NRG) own and operate a gas distribution system (NRG System) in Ontario. NRG's franchise area is located south-east of London and includes the towns of Aylmer, Belmont, Brownsville, Port Burwell, Springfield, Straffordville, and Vienna. A map showing the NRG System and the NRG franchise area is attached in Appendix A.

Gas is supplied into the NRG System from Union Gas Limited (UGL) at 7 different locations: Belmont Station, Harrietsville Station, Brownsville Station, Bayham Station, Eden Station, and North Walsingham Station. Gas is also supplied from gas wells owned by the NRG Gas Corporation (NRG Gas Corp wells), located in the NRG franchise area.

The gas demands in the NRG System are mainly for residential heating, small industrial customers, and grain drying. The residential heating demand peaks during the winter months, the small industrial customers include heating which means that they peak in the winter, while the grain drying demand usually occurs in autumn or winter, but can occur at any time during the year.

NRG are currently experiencing periods of very high gas demand, usually on cold days when grain drying is under way, where gas pressure gets very low in certain parts of the system. NRG want to determine if there are viable, cost effective alternatives to the purchase of natural gas from their current suppliers to maintain adequate system pressures and volumes required to meet this seasonal demand. Alternatives could include: looping existing pipelines in the system, adding new pipelines to the system, modifications to UGL interconnects, and connections to new gas wells.

NRG have contracted SNC-Lavalin Inc. (SNC-Lavalin) to study NRG's existing gas distribution system and recommend viable solutions to meet NRG's requirements. This report contains the results of the study.

2. OBJECTIVES AND SCOPE

SNC-Lavalin used the following steps to complete the study:

- Build a model of the NRG System in DNV-GL's transient hydraulic pipeline simulation tool, the Synergi Pipeline Simulator (SPS).
- Simulate the NRG System using actual data. Winter residential data will be used when grain drying is also underway to simulate the highest gas demand in the system.
- Benchmark the simulation to confirm that the model matches actual NRG System performance.
- Test various solutions to alleviate low pressure conditions in the NRG System.
- In concert with NRG select the optimum solution taking NRG's judgments on constructability, and cost into account

- Test the optimum scenario by increasing gas demand in the NRG System

3. INPUT DATA AND ASSUMPTIONS

A cold front moved into the NRG franchise area on November 12th, 2014 dropping temperatures by about 20°C over a short period of time and creating a large gas demand from residential customers. In conjunction with this, grain drying was occurring at various farms within the NRG franchise area. NRG noted that gas pressures in the system during this time period were very low.

NRG has provided data from November 12th, 2014 to be used as input to the SPS model to simulate the highest gas demand case. In the tables of input data below, data from November 12th, 2014 is identified as "Actual Data". Pipeline pressures at various locations in the NRG System that were used to benchmark the model are contained in section 3.6.

The data for the study was collected from the documents provided by NRG. Each document has been attached in Appendix B for reference. Appendix B contains the following:

- General Transient Analysis Data Requirements
- Pipe specification
- E-mail containing input data
- Direct Purchase Twelve Month Volume Report of November 21st, 2014
- Gas pressure at all measured locations on November 12th, 2014
- E-mail containing input data
- E-mail containing input data
- Gas flow rates on November 12th, 2014
- E-mail containing input data
- Contracted labour and material costs for SW Ontario Market
- Base Map of NRG system. Note that the CAD drawing contains additional details of customer connections
- Town Maps for Aylmer, Belmont, Brownsville, Port Burwell, Springfield, Straffordville, and Vienna

The NRG model was separated into two parts:

- Belmont — Belmont Station and the Northern portion of the town of Belmont
- Main System — The southern portion of the town of Belmont and the remainder of the NRG System

This report focuses on the main system which was affected by the November 12th, 2014 cold front while the Belmont section of the system was not significantly affected by the cold front.

SNC-Lavalin has used their previous experience and best judgement to assume typical values for any data required by the SPS model that NRG was unable to provide. This data is marked as "Assumed" below.

3.1. FLUID PROPERTIES

Typical natural gas composition for the NRG System is shown in Table 3.1-1.

Table 3.1-1 The NRG Gas Composition

Component	% Mole
C_1	94.85
C_2	3.40
C_3	0.16
C_4	0.04
C_5	0.01
C_6+	0.01
N_2	0.80
CO_2	0.69
O_2	0.01
H_2	0.03
Total	100.00

3.2. PIPELINE PHYSICAL DATA & SOIL PROPERTIES

The applicable pipeline physical data for this study were collected from the documents provided by NRG (see Appendix B). The pipes are made of Medium Density Polyethylene (MDPE). The pipe physical data and the soil properties are shown in Table 3.2-1.

Table 3.2-1 Pipeline Physical Data and Soil Properties

Description	Parameter
Maximum Allowable Operating Pressure (Winter)	80 psig
Assumed Ground Temperature (Winter)	0.0 ℃
Assumed Pipe Depth of Burial	20 in
Assumed Pipe Roughness	0.005 mm
Assumed Pipe Thermal Conductivity	0.398 W/m°C
Assumed Pipe Heat Capacity	2.35 KJ/Kg°C

Description	Parameter
Pipe Density	939 Kg/m^3
Assumed Winter Soil Thermal Conductivity	0.5 W/m°C

Pipe wall thickness is different depending on the pipe size used in the gas network. The pipe nominal sizes and wall thicknesses are presented in Table 3.2-2.

Table 3.2-2 Nominal Pipe Sizes and Wall Thicknesses Used in the Model

Nominal Size (Inches)	Wall Thickness (Inches)
6	0.576
4	0.391
3	0.304
2	0.216
1 ¼	0.166
1	0.120

3.3. VALVE DATA

The valve flow coefficients (Cv) for the block valves have been summarized in Table 3.3-1. Typical valve data for the block valves were assumed based on previous experience.

Table 3.3-1 Block Valve Data

Valve Size (NPS)	Valve Type	Fully Open Valve Coefficient - Cv (USGPM/psi0.5)	Cv Opening and Closing Curve
6	Gate	2020	Linear
4	Gate	850	Linear
3	Gate	500	Linear
2	Gate	165	Linear

There are a number of valve stations in the NRG System. The locations of these valve stations are shown in Figures 3.3-1 to 3.3-6.

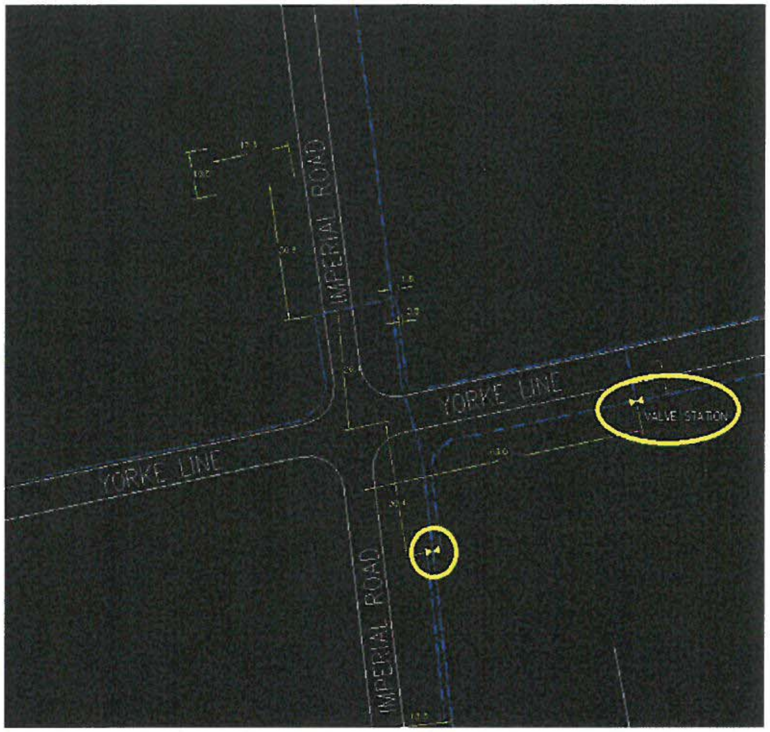


Figure 3.3-1 The Imperial Road and York Line Valve Stations

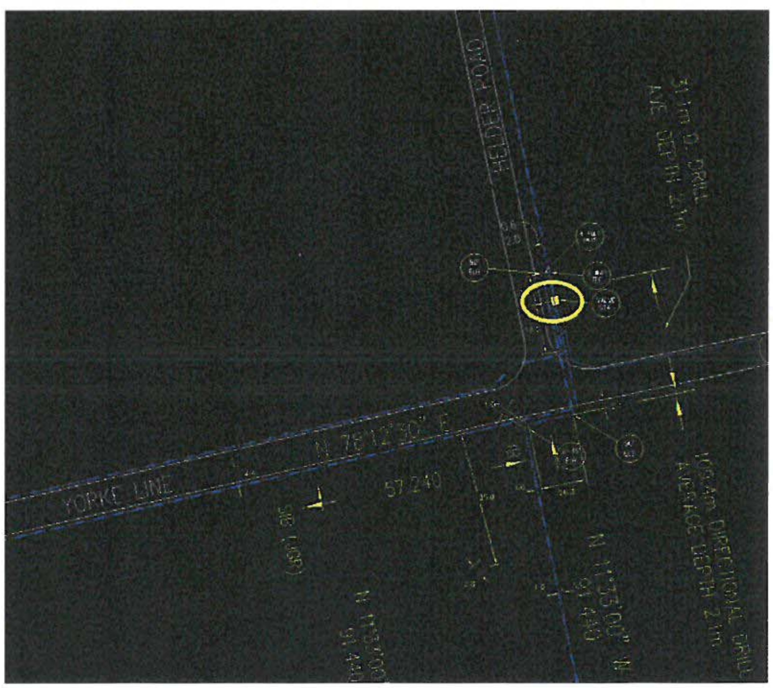


Figure 3.3-2 The Helder Road Valve Station

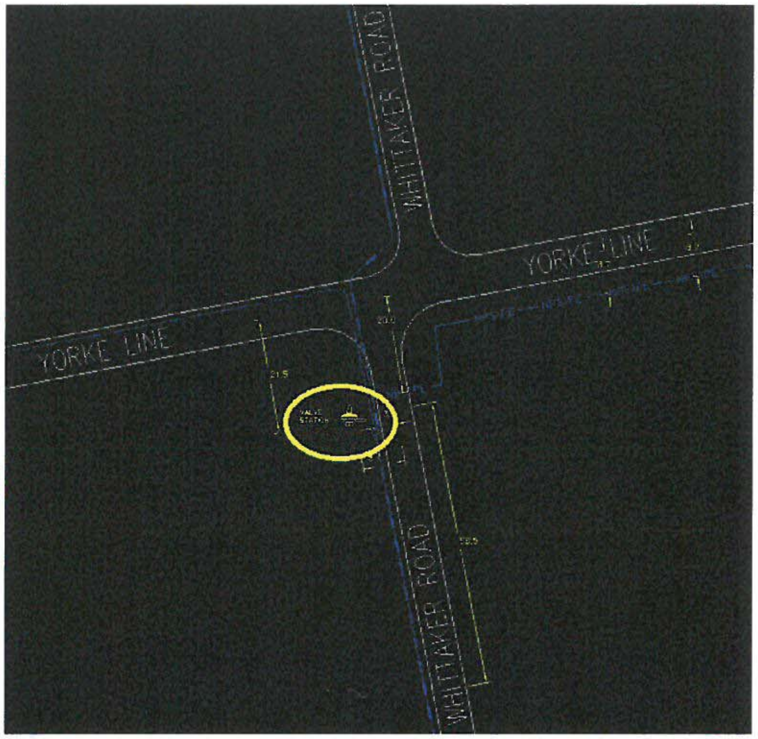


Figure 3.3-3 The Whittaker Road Valve Station

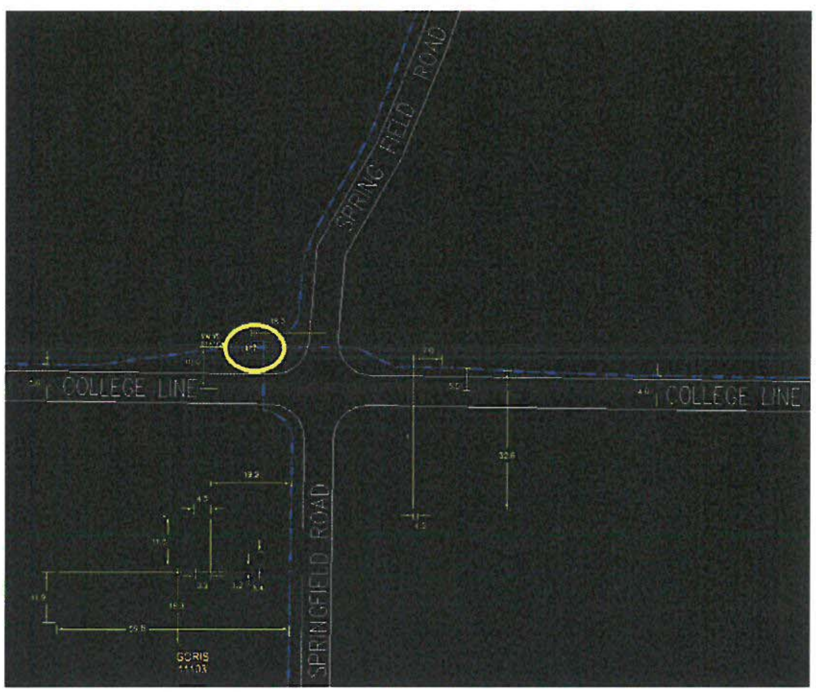


Figure 3.3-4 The Springfield Road Valve Station

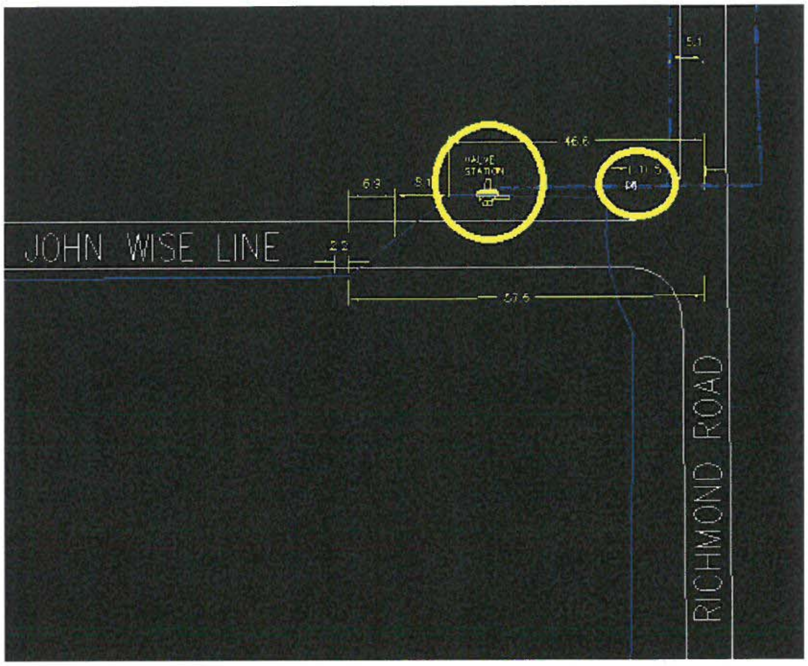


Figure 3.3-5 The Richmond Road Valve Station

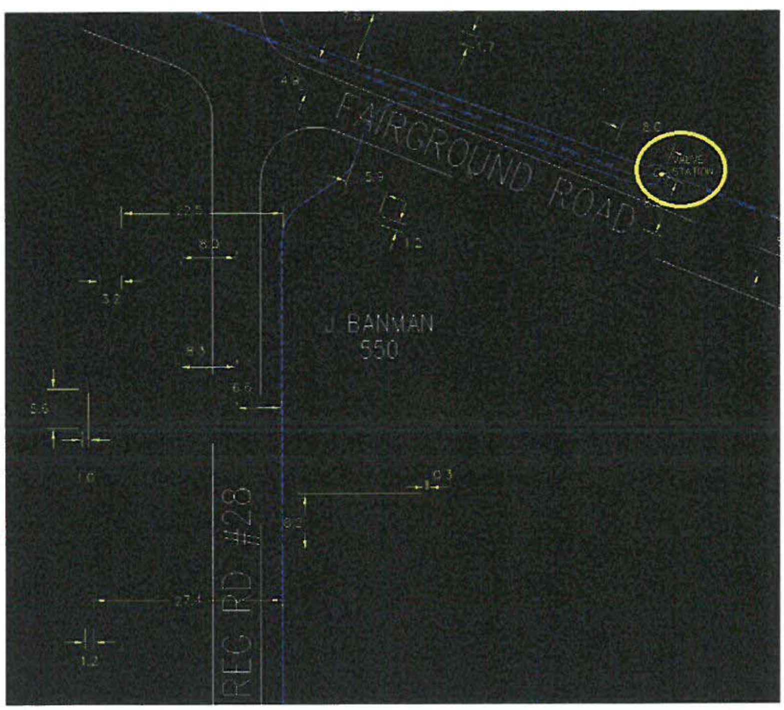


Figure 3.3-6 The Fairground Road Valve Station

3.4. GAS REGULATOR DATA

The datasheets for the gas regulators were not available; therefore, the required data is based on a typical control valve Cv for the corresponding valve size. The assumed gas regulator data is presented in Table 3.4-1.

Table 3.4-1 Gas Regulator Data

Regulator Location	Regulator Size (NPS)	Fully Open Valve Coefficient - Cv (USGPM/psi0.5)	Cv vs Stem Position Curve	Upstream Pressure Set-Point (psig)	Downstream Pressure Set-Point (psig)
Belmont North	2	30.1	Equal Percentage	33	-
Belmont South	3	40	Equal Percentage	78	-
Brown NovaScotia	4	50.1	Equal Percentage	-	30
Culloden	2	30.1	Equal Percentage	38	-
Glencolin	4	50.1	Equal Percentage	65	-
Hacienda Talbot	4	50.1	Equal Percentage	-	52
Aylmer North	4	50.1	Equal Percentage	65	
Brownsville North	2	30.1	Equal Percentage	-	30
Imperial	4	50.1	Equal Percentage	-	28
Port Bruce	4	50.1	Equal Percentage	-	30
Rogers Mushroom	2	30.1	Equal Percentage	-	30
Talbot	2	30.1	Equal Percentage	42	-
Vienna Tunnel	2	30.1	Equal Percentage	-	30

3.5. OPERATING DATA

There are seven UGL Stations that supply natural gas into the NRG System. The flow rate on November 12th, 2014, for each station is shown in Table 3.5-1.

Table 3.5-1 Supply Parameters

Supply	Supply Pressure (psig)	Flow Rate (m^3/hr)
Bayham Station	79	1207
Belmont Station	Assumed 80	521
Brownsville Station	Assumed 50	49
Eden Station	83	1167
Harrietsville Station	89	3621
North Walsingham Station	83	997
Putnam Station	81	1604

The gas wells in the NRG franchise area have been added together based on location and included in the model in 3 groups. The well group locations and flow rate on November 12th, 2014, are shown in Table 3.5-2.

Table 3.5-2 Gas Well Group Locations

Well Group	Location	Actual Flow Rate (m^3/hr)
1	On 2nd Concession Rd north of Barth Side Rd	78
2	Fairground Rd and Regional Rd #28	204
3	Nova Scotia Line Between Richmond Rd and Woodworth Rd	204

Note that the gas well groups are referred to in this report using a "group name" as shown in Table 3.5-3.

Table 3.5-3 Gas Well Group Names

Gas Well Group Location	Group Name
On 2nd Concession Rd north of Barth Side Rd	2nd Concession
Fairground Rd and Regional Rd #28	Fairground
Nova Scotia Line Between Richmond Rd and Woodworth Rd	Scotia Line

There are 9 towns in the NRG franchise area that form the major residential deliveries. In addition, there are many farms outside these towns that consume a significant portion of the gas flow. The following assumptions were made to estimate the flows to each customer:

- The average annual dwelling consumption is 2400 m^3
- The distribution of dwellings between each town was determined by a manual count of dwellings on each town map.

- The average dwelling consumption was increased to account for dwellings not counted on the map.
- Farm consumption for grain drying or other activities is determined based on the corresponding flow rate that achieves the pressure benchmark data.
- Pressure benchmark data are assumed to occur simultaneously.

The number of dwellings within each large town was estimated by NRG and is shown in Table 3.5-4.

Table 3.5-4 Number of Dwellings in each Town

Town	Number of Dwellings
Aylmer	2030
Belmont	555
Brownsville	150
Nilestown	100
Port Burwell	319
Port Bruce	150
Springfield	235
Straffordville	150
Vienna	150

3.6. BENCHMARK DATA

Actual supply pressures and locations for the high flow rate day November 12th, 2014 are shown in Table 3.6-1. Pressures provided are assumed to be gauge pressure.

Table 3.6-1 Benchmark Pressures

Location	Actual Pressure (psig)	Type
North Walsingham	83	UGL Input
New England	79	UGL Input
Putnam Station	81	UGL Input
Harrietsville Station	89	UGL Input
Ridge Rd	83	UGL Input
Rogers Rd and Talbot Ln	42	Feeding town of Aylmer
Hacienda Rd and Talbot Ln	52	Feeding town of Aylmer
John St South at Bradley Creek	51	Feeding town of Aylmer
Beech St	65	Feeding town of Aylmer
Belmont South	78	Feeding town of Belmont
Belmont North	33	Feeding town of Belmont
Port Bruce	53	Feeding town of Port Bruce
Brownsville South	38	Feeding town of Brownsville
Vanmoerkerke	63	Customer

Location	Actual Pressure (psig)	Type
YPMA	9	Customer
Sylvite Avon	55	Customer
FS Partners Straffordville	54	Customer
Klassen Farms	55	Customer
Kingsmill Grain	21	Customer
Graydon Farms	33	Customer
Isaak Bartsch	59	Customer
Best Line Farms	35	Customer
Herman	74	Check Point
Doerksen	60	Check Point
Whittaker Rd and Yorke Ln	79	Check Point

3.7. SEED FLOW RATES

The flow rates in Table 3.7-1 were input into the SPS model and used as an initial seed to help the model get to steady state conditions faster. These flow rates were the highest flow rates seen in NRG's Direct Purchase Twelve Month Volume Report of November 21st, 2014. Town flow rates were increased by the number of dwellings in that town. These flow rates were modified as required to match flow rates shown in Tables 3.5-1 and 3.5-2 and the gas pressures in Table 3.6-1 above.

Table 3.7-1 Seed Flow Rates

Location	Flow Rate (m^3/hr)
Aylmer	480
Belmont	130
Brownsville	23
Nilestown	15
Port Burwell	73
Port Bruce	34
Springfield	54
Straffordville	23
Vienna	23

3.8. ASSUMPTIONS

The following assumptions were made to complete this study.

1) All the existing valves in the system are open at all times during normal operation.
2) The consumption of residential and industrial gas take-offs is known and the delivery pressure is calculated by SPS.
3) The "Dedicated 6" Line – IGPC", shown on the NRG System Map, is not included in the NRG System.
4) There are no significant elevation differences in the NRG franchise area.
5) The benchmark pressure data occurs simultaneously.
6) The maximum discharge pressure to the system from the UGL Stations is limited to 80 psig so that it does not exceed the MAOP of the line.
7) Gas demand from dwellings not accounted for the in the town maps are included in other take-offs across the network.
8) All known grain drying farms are assumed to be operational and draw gas at a rate dictated by their corresponding inlet pressures on the high flow day of November 12th, 2014.

4. CALCULATIONS AND METHODOLOGY

The hydraulic calculations were conducted using SPS by DNV-GL, Version 10.0. SPS is a network modeling software package designed for the analysis of steady-state and transient pipeline operation.

The gas flow rates in Tables 3.5-1 and 3.5-2 and the gas pressures in Table 3.6-1 were input into the SPS model. SPS then calculated a flow rate for all gas customers in the system and resolved to a steady state.

Once a steady state for November 12th, 2014 had been achieved, SPS calculated flow rates were used as inputs to the model and gas pressures were calculated by SPS.

The working model contains a gas take-off flow rate for each customer and a gas input flow rate for each UGL station and the gas well groups.

5. BENCHMARKING RESULTS

The results of the benchmarking using data for November 12th, 2014 are shown graphically on the Benchmark Results Schematic in Appendix C. Note that the layout of the NRG System on the Benchmark Results Schematic (and all of the other schematics included in this report) is a very close approximation of the NRG System Map, but not an exact match.

Please also note that the loops and pipeline extensions that were tested during the course of this study are also shown on all of the schematics. Each of the loops or extensions has block valves that are used to isolate the pipe. In most cases, the block valves are closed and the additional pipe is not included in the simulation. When the loop or extension is in operation, the block valves are open and the loop or extension has been circled on the schematic.

Color is used to denote gas pressures calculated by SPS on the schematic. Darker colors (black, blue, and purple) denote areas of higher pressure (>= 50 psi), green denotes the mid-point pressure (>= 40 psi < 50 psi) while lighter colors (yellow and red) denote areas of lower pressure (< 40 psi).

On the schematic, lower pressure areas are noted around Brownsville and in the Southwest quadrant of the NRG franchise area. NRG reviewed these results and confirmed that they were a close match to the actual results that are seen in their franchise area during high gas demand days.

A comparison of the actual pressures from November 12th, 2014 and the pressures calculated by SPS is shown in Table 5-1. The difference between the actual and calculated pressures is also shown in the table.

Table 5-1 Actual and Calculated Pressures

Location	Actual Pressure (psig)	Calculated Pressure (psig)	Pressure Differential (psi)
North Walsingham	83	77	6
Bayham	79	79	0
Putnam Station	81	81	0
Harrietsville Station	89	83	6
Eden	83	75	8
Rogers Road and Talbot Line	42	34	8
Hacienda Road and Talbot Line	52	48	4
John St S at Bradley Creek	51	47	4
Beech St	65	64	1
Belmont South	78	78	0
Port Bruce	53	53	0
Brownsville South	38	38	0
Vanmoerkerke	63	63	0
YPMA	9	11	2
Sylvite Avon	55	55	0
FS Partners Straffordville	54	54	0
Klassen Farms	55	55	0
Kingsmill Grain	21	21	0
Graydon Farms	33	33	0
Isaak Bartsch	59	59	0
Best Line Farms	35	35	0

Location	Actual Pressure (psig)	Calculated Pressure (psig)	Pressure Differential (psi)
Herman	74	74	0
Doerksen	60	59	1
Whittaker Road and Yorke Line	79	72	7

The differences in pressure between the actual pressure and the pressure calculated by SPS are small enough that the model can be deemed to match the system during the high demand day of November 12th, 2014.

To match the gas pressures in the NRG System as shown above, SNC-Lavalin modified the "seed" flow rates as shown in Table 5-2.

Table 5-2 Modified Seed Flow Rates

Location	Modified Flow Rate (m^3/hr)	% Increase over previous estimate
Aylmer	1750	265%
Brownsville	70	200%
Port Burwell	162	120%
Port Bruce	0≠	N/A
Springfield	146	170%
Straffordville	74	220%
Vienna	47	100%

≠ Pressures at the town gate for Port Burwell are lower than the required pressure so the flow rate is listed as zero (0).

6. IMPROVING SYSTEM INTEGRITY

The model shown in the Benchmark Results Schematic was deemed the baseline model and used as the starting point for further study. This baseline model was modified to attempt to alleviate the low pressure areas in the southwest and around Brownsville. Modifications that were considered to the system configuration included:

- Looping existing pipelines in the system
- Adding new pipelines to the system
- Modifications to UGL interconnects
- Increasing flow rates from gas wells

The Benchmark Results Schematic was analysed to determine areas of high pressure that could be easily connected to lower pressure areas. Doing so would better use the existing system capacity.

6.1. LOOPS AND LINE EXTENSIONS

Loops and extensions to existing lines were added to the NRG System to attempt to move gas from the higher pressure areas into the lower pressure areas. The following loops and extensions were added to the system and will be further discussed below:

- John Wise Line Loop
- Glencolin Line Extension
- Wilson Line Extension
- Talbot Line Extension

In addition to the loops and line extensions above, the following were considered and rejected as having no benefit or less benefit than the above. These loops and extensions will not be discussed further in this report:

- Carlton line extension from Bogus Road to Richmond Road
- Elgin Country Road extension from Jackson Line to Light Line
- Hacienda Road extension from Glencolin Road to Dingle Line
- Pigram Line Extension from Avon Drive to Wilson Line
- Loop of line to high demand gas customer in Kingsmill
- Loop of pipe to YPMA
- Springwater Road extension from just north of Brouwers Line to Conservation Line
- Springwater Road extension from just north of Brouwers Line to John Wise Line
- Lyons Line/Brownsville Road extension from Lyons Line at Putnam Road to Pigram Line then along Brownsville Road

6.1.1. JOHN WISE LINE LOOP

The John Wise Line pipe was looped between Imperial Road and Springfield Road to try and move gas into the south-west quadrant of the NRG system. An NPS 3 loop was added of approximately 4070 m in length.

Adding the John Wise Line loop had negligible impact on system. Pressures were somewhat higher around Aylmer, but still low throughout the south-west quadrant. In general, the average pressure at pipeline intersections was constant and with no area having an increase of more than 2 psi. The result of this simulation is shown in Appendix D.

Looping the John Wise Line pipe had an insignificant effect on the NRG system.

6.1.2. GLENCOLIN LINE EXTENSION

The Glencolin Line pipe was extended from Glencolin Line, approximately midway between Imperial Road and Rogers Road, to Springwater Road to try and move gas into the south-west quadrant of the NRG system. An NPS 4 pipeline was added of approximately 3500 m in length.

Extending the Glencolin Line had a significant impact on the system. Higher pressures were seen in the south and south-west quadrants of the system. Pressures west of Aylmer increased by approximately 10 psig and pressure in the south-west quadrant increased significantly. The result of this simulation is shown in Appendix D.

6.1.3. WILSON LINE EXTENSION

The Wilson Line pipe was extended from Putnam Road to Whitaker Road to try and increase gas flow into the Brownsville area. An NPS 3 pipeline was added of approximately 500 m in length.

Extending the Wilson Line did not have a significant impact on the system. Gas flow into the Brownsville area is limited by the pressure regulator on Ostrander Road near Pigram Line that is set to 30 psig and the check valve on Culloden Line near Keswick Road that doesn't allow gas flow to the north. The result of this simulation is shown in Appendix D.

Increasing the set pressure of the pressure regulator to 50 psig, in addition to extending the pipe along the Wilson Line, increases pressures in the Brownsville area above 30 psig. The result of this simulation is shown in Appendix D. However, increasing the set pressure of the Ostrander Road pressure regulator will most likely require that a large number of pressure regulators be installed at individual take-offs further downstream.

Adding a loop to the Ostrander Road pipeline, in addition to extending the pipe along the Wilson Line, helps to alleviate the low pressures areas around Brownsville. The pressures in the Brownsville area increase to just less than 30 psig, with the gas pressure of the high demand gas customer on Culloden Line increasing to 27 psig. And of course, increasing the set pressure of pressure regulator as well as adding the Ostrander Road Loop increases the downstream pressures to slightly higher than 30 psig.

6.1.4. TALBOT LINE EXTENSION

The Talbot Line pipe was extended from Culloden Road to just past Springer Hill Road to try and move gas into the south-west quadrant of the NRG system. An NPS 4 pipeline was added of approximately 4500 m in length.

Extending the Talbot Line did have an impact on the eastern part of the southwest quadrant of the NRG system. System pressures in that section of the line were increased by approximately 10 psig. However, the system pressures around Alymer were not significantly affected. The result of this simulation is shown in Appendix D.

6.2. INCREASING GAS FLOW FROM UGL STATIONS

Increasing gas flow rates from the UGL stations could transport additional gas into the south and around Brownsville. Increasing the flow limits of Eden and Brownsville Stations, and increasing the pressure at the Bayham Station to 80 psig increased average system pressures by 0.8 psi with some customers experiencing delivery pressure increases of 3 psi or more, but did not have a significant impact on the south-west quadrant of the system.

Solely increasing the gas supply from UGL Stations has a small impact on the system.

6.3. NRG GAS CORP WELLS

6.3.1. NO NRG GAS CORP WELLS

When gas flow from the NRG Gas Corp Wells is shut-in, much lower pressures are seen in the south and south-west with most of the system at less than 30 psig. This indicates that the NRG Gas Corp wells have a significant impact on the NRG system. A flow schematic showing the results of this simulation is shown in Appendix E.

If the NRG Gas Corp wells were removed from the NRG system additional gas flow would be required from the UGL Stations and additional pipelines would be required to move gas from the UGL stations into the southern areas of the system.

6.3.2. HIGHER FLOW RATES FROM THE NRG GAS CORP WELLS

When gas flow rates are quadrupled from the Scotia Line group of wells, higher pressures occur in the south and south-east, but low pressures still occur in the south-west. Gas flow rates from the Scotia Line group of wells must increased by 7 times in order to increase pressure in the south-west. A flow schematic showing the results of this simulation is shown in Appendix E.

Increasing gas flow from the NRG Gas Corp wells could alleviate low pressures in the southern areas of the NRG System. However, the increase in flow rate is significant.

6.3.3. HIGHER GAS FLOW RATES AND THE JOHN WISE LINE LOOP

Increasing the gas flow rate from the NRG Gas Corp Wells as well as looping the John Wise Line helps to move gas from the central south into the south-west. A flow schematic showing the results of this simulation is shown in Appendix E. For this simulation the John Wise line was looped between Imperial Road and Springfield Road (NPS 3 approximately 4070 m).

Adding the John Wise Line loop decreases the requirement for additional gas. Quintupling the gas flow rate from the Scotia Line group of wells and looping the John Wise line is roughly equivalent to increasing gas flow from the Scotia Line group of wells 7 times.

Quintupling gas flow from the Scotia Line group of wells as well as looping the John Wise Line is an effective way of increasing gas availability in the south and moving gas into the south-west.

7. CONCLUSIONS AND RECOMMENDATIONS

The NRG gas distribution system was modelled and benchmarked to a high gas flow day on November 12th, 2014. The simulated results were deemed to be a good representation of the actual system on the high flow day. A series of modifications were made to the model to attempt to alleviate low pressure areas in the south-west and around Brownsville.

Based on the simulations completed, it appears that the NRG system integrity problem is that gas cannot move freely from the inlet locations, in the north and east, into the south-west quadrant and into the Brownsville area. It should be noted that the total flow rate into the NRG system closely matches the total flow take-off from the NRG system. Loops and extensions of existing pipes were the most effective way of moving gas into the low gas pressures areas of the system.

7.1. SOUTH-WEST QUADRANT

The simulation results showed that there were three viable alternatives to alleviate low pressure in the south-west quadrant of the system:

1. Extending the Glencolin Line pipe
2. Increasing gas flow from the Scotia Line well group by 7 times
3. Quintupling gas flow from the Scotia Line well group and looping the John Wise Line

Extending the Glencolin Line is the more attractive alternative because it appears to be much simpler and much less extensive than looping the John Wise Line and increasing gas flow from the NRG Gas Corp wells.

7.2. BROWNSVILLE AREA

The simulation results showed that there were two viable alternatives to alleviate low pressure in the Brownsville area of the system:

1. Extending the Wilson Line and increasing the set pressure on the Ostrander Road pressure regulator to 50 psi
2. Extending the Wilson Line and looping the Ostrander Road Line

Extending the Wilson Line and looping the Ostrander Road Line is the more attractive alternative as changing the Ostrander Road regulator set pressure will most likely require that a large number of pressure regulators be installed at individual take-offs further downstream.

7.3. RECOMMENDATION

The Glencolin Line extension, the Wilson Line extension, and the Ostrander Road Loop were simultaneously added to the model. A flow schematic showing the result of the high gad flow day is shown in Appendix F.

The result shows that the low pressure areas in the south-west quadrant and around Brownsville have been eliminated. The Brownsville area is still colored red on the results schematic, because the Ostrander Road pressure regulator is set to 30 psig. However, the pressures have increased substantially with the lowest pressure at 26 psig.

It is recommended that the Glencolin Line and the Wilson Line be extended and the Ostrander Loop be added to the NRG system.

8. COST ESTIMATE

An unclassified estimate was prepared for the recommended modifications above:

- Glencolin Line Extension
- Wilson Line Extension
- Ostrander Road Loop

The cost estimates are factored estimates based on data obtained from NRG on similar work and exclude NRG's costs, land costs, telecommunications, environmental assessments, legal and regulatory, third party consultation, escalation, and NRG's risk.

NRG has advised that a construction survey is not required in their franchise area.

The total cost for each pipeline segment is shown in Table 8-1. A breakdown of the costs for each pipe segment is shown in Appendix G.

Table 8.1 – Unclassified Costs estimate

Extension	Pipe Diameter	Length (m)	Cost (CAD $)
Glencolin Line Extension	NPS 4	3200	213,800
Wilson Line Extension	NPS 3	500	34,800
Ostrander Road Loop	NPS 3	4060	207,900
Total	-	-	**456,500**

9. GROWTH LIMITATIONS

The NRG system could be impacted by two different types of growth:

- Increase in population in the area
- Increase in the number of high demand gas customers

The NRG system with the Glencolin Line and Wilson Line extensions and the Ostrander Loop added into the system were investigated with the two types of growth described above.

9.1. INCREASE IN POPULATION

The Ontario Ministry of Finance (Ontario) has produced population projections for the Region and Census Divisions in Ontario. The NRG Franchise generally lies within the Elgin Census Division and Ontario predicts a population increase of 3.4% in the region by the year 2021. To simulate this increase in population we increased the demand from each customer by 3.4% and increased the gas flow rate into the NRG system from the UGL stations and from the NRG wells by 3.4%.

The result of increasing the gas demand to match a 3.4% increase in the population is shown as a flow schematic included in Appendix H.

The results schematic is very similar to the recommended results schematic from Section 7 above, except that the gas pressure in the south-west are approximately 3 psi lower.

If the population in the area increases in a uniform way throughout the franchise area, then the NRG system when the recommended modifications have been made to the system should be able to meet the demand for gas.

9.2. INCREASE IN THE NUMBER OF HIGH DEMAND GAS CUSTOMERS

High gas demands customers, such as grain dryers, have a large impact on the NRG system. It is impossible to predict where the next high gas demand customer could be introduced into the system, so high demand gas customers were simulated in various locations in the NRG system.

The high demand customer was assumed to be equivalent to the highest average monthly flow rate to Kingsmill Grains (277 m^3/hr). This flow rate was added in various locations throughout the NRG franchise area (the 277 m3/hr was added to an existing customer's gas flow rate). An equivalent flow was then added to the nearest UGL station and/or to the NRG Gas Corp group of wells to provide gas for this customer. The simulation was run and the results were observed.

In general, if a new high demand customer added in close proximity to a UGL station, an NRG Gas Corp group of wells or in the north, modifications will not be required to the NRG system, as long as gas from the nearby station and/or group of wells can be increased to satisfy the customer's gas demand.

If a new high demand customer is added in the south-east the line feeding the customer and in some instances the lines immediately upstream of the customer would need to be looped.

If a new high demand customer is added in the south-west then looping would be required.

Examples of high demand customer simulations performed are as follows:

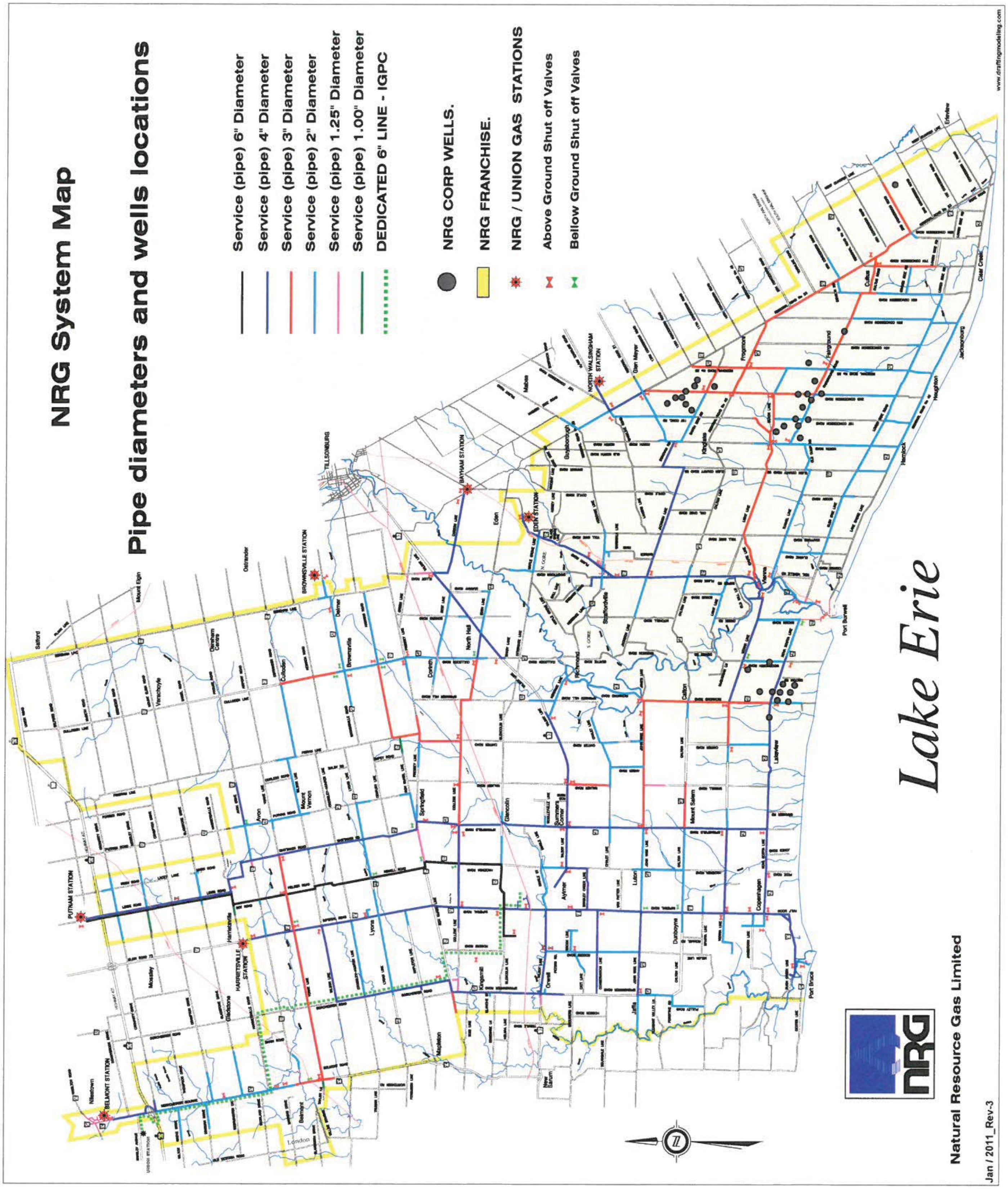
- On Avon Drive near Pigram Road
  - Gas flow must be increased from Putnam and Harrietsville Stations
  - Slight decrease in gas pressures (5 psi) along Putnam Road
- On Pressey Line near Springer Hill Road
  - Gas flow must be increased from Putnam, Bayham, and Harrietsville Stations
  - Slight decrease in gas pressures (3 psi) along Hawkins Road
- On Lyons Line near Newell Road
  - Gas flow must be increased from Harrietsville Station and a slight increase from Putnam Station

- No significant pressure drop in the system

- On Chalet Line off Springfield Road
    - Gas flow must be increased from Putnam Station and a slight increase from Bayham Station
    - Gas pressure decreases by about 10 psi in the centre of the south-west section of the system
- On Pulley Road
    - Gas flow must be increased from Putnam and Harrietsville Stations and the Scotia Line group of wells
    - Very low gas pressures (17 to 29 psi) along Pulley Road. Would need to loop Pulley Road, Forsythe Road, and lower portion of Springwater Road
- On Vienna Line and Carter Road
    - Gas flow must be increased from the Scotia Line group of wells, and Eden and North Walsingham Stations
    - A portion of the Vienna Line must be looped
- On 3rd Concession Road
    - Gas flow must be increased from the Fairground group of wells, and either the 2nd Concession group of wells or the North Walsingham Station
    - No significant pressure drop in the system
- On Clark Road and Glen Erie Line
    - Gas flow must be increased from the Fairground group of wells and Eden Station
    - Clark Road and Tunnel Line and Glen Erie Line must be looped

It is recommended that a steady state simulation be performed when a new high demand gas customer is added to the system to determine the impact that this will have on the NRG system and the modifications required, if any, to meet the new demand.

Appendix A – NRG System Map


NRG System Map
Pipe diameters and wells locations
Service (pipe) 6" Diameter
Service (pipe) 4" Diameter
Service (pipe) 3" Diameter
Service (pipe) 2" Diameter
Service (pipe) 1.25" Diameter
Service (pipe) 1.00" Diameter
DEDICATED 6" LINE - IGPC
NRG CORP WELLS.
NRG FRANCHISE.
NRG / UNION GAS STATIONS
Above Ground Shut off Valves
Bellow Ground Shut off Valves
Lake Erie
PUTNAM STATION
BELMONT STATION
HARRIETSVILLE STATION
BROWNSVILLE STATION
BAYHAM STATION
EDEN STATION
NORTH WALSINGHAM STATION
TILLSONBURG
Aylmer
Port Bruce
Port Burwell
Springfield
Belmont
London
Natural Resource Gas Limited
Jan / 2011_Rev-3
www.draftingmodeling.com

Appendix B – Reference Documents

GENERAL TRANSIENT ANALYSIS DATA REQUIREMENTS

1) Elevation profile in an electronic format

- Not applicable. I suspect that this is only applicable to a singular high volume pipeline.

2) Pipeline diameter, MAOP, wall thickness, design temperature, and internal roughness

- Pipe Diameter – See base map already provided earlier;
- MAOP – the MAOP of our system is 80psig;
- For wall thickness, design temp and internal roughness – See Appendix A; specifications of the pipe currently being purchased and installed. We would have to assume that all pipe previously installed has the similar properties to achieve CSA approval.

3) Gas composition in mole percent of each component

Ontario: Typical Gas Higher Heating Value [Union Gas Ltd. service area]		Jan-Jun 2013	Jul-Dec 2013
Natural Gas HHV	(GJ/standard* m3)	0.038	0.038
Ontario: Typical Gas Composition [Union Gas Ltd. service area]			
Methane	mole %	94.85	94.66
Ethane	mole %	3.40	3.77
Propane	mole %	0.16	0.17
Butane	mole %	0.04	0.03
Pentanes	mole %	0.01	0.00
Hexanes+	mole %	0.01	0.00
Nitrogen	mole %	0.80	0.76
Carbon dioxide	mole %	0.69	0.56
Oxygen	mole %	0.01	0.02
Hydrogen	mole %	0.03	0.03
Total	mole %	100.00	100.00

*Standard conditions: 15°Celsius, 101.325 kPa

This information is provided solely for the use of the reporting operations related to their compliance reporting obligation under Ontario Regulation 452/09 under the Environmental Protection Act, where applicable. While every effort has been made to ensure the accuracy of this information, Union Gas does not warrant accuracy of the information for any purpose. Union Gas provides no guarantee regarding gas composition or high heating value for any specific delivery point.

4) Gas flow rate, temperature and pressure at each input location

- Please see the chart below for flow rates. Pressures are noted on the map provided.

Location	Max Hourly Volume (m3/hour)
Harrietsville	2,950
Putnam	3,258
Eden	1,250
Bayham	2,000
Walsingham	1,250
Belmont	538
Brownsville	170

5) Gas flow rate and pressure at each take-off point;

- Not applicable

6) Location, type and Cv of all valves

- The locations of all valves are located on the base map that was previously provided. In terms of the type of valve and CV that information in not available.

7) Location and performance information and control logic for all compressor stations

- There are no compressor stations in our franchise area.

8) Set points for all controls on the system (discharge pressure, back pressure, flow rate, etc.)

- Pressures and flow rates are variable based on the customer load/season requirements and commercial customer requirements.

9) Pressure reduction station locations and pressure reduction set-points

- See Appendix B

10) Schematic diagrams for the system

- You may find this detail on the base System Map already provided

11) System operating manuals (or philosophy/procedure)

- Per Z662.07 as per Regulations and Codes. Maintenance Protocol is available if required

12) P&IDs for the system

- N/A

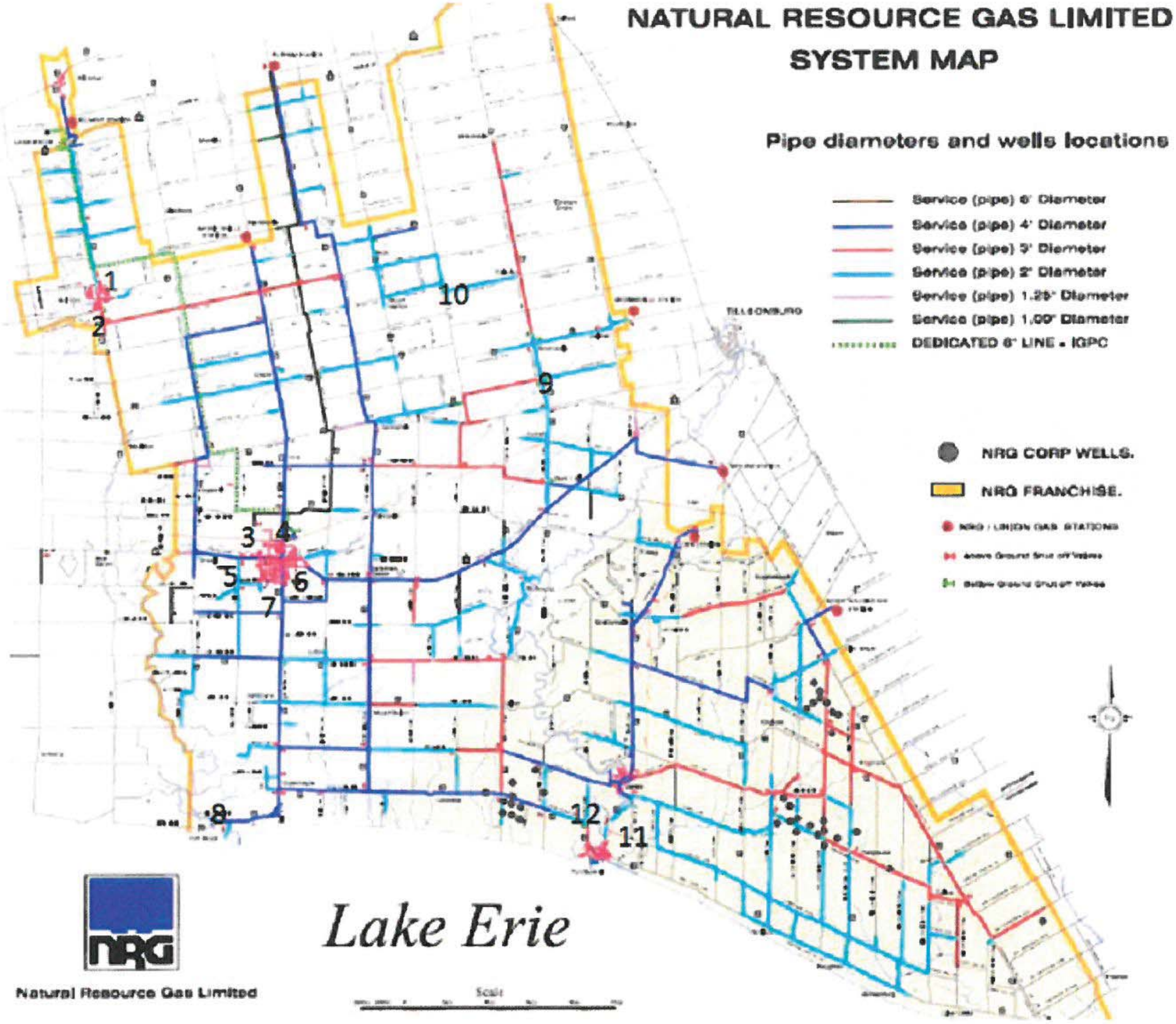
13) Maximum and minimum ground temperatures at pipe burial depth and soil thermal conductivities

Cond. mS/cm	Rating
0-0.25	Low
0.26-0.45	Medium
Temp range	SW. ON

14) Pipe burial depth

- 20” to 48” maximum depth per code.

Appendix B



Outlet Pressures from each Transfer Station	Map No.	Governed Pressure
Belmont Station: 30 PSI to Nilestown	1	30 PSI outlet to Belmont
Putnum Station: 60-80 PSI outlet pressure	2	30 PSI outlet to Belmont
Harrietsville Station: 60-80 PSI outlet pressure	3 – 7	30 PSI outlet to Aylmer
Brownsville Station: 30 PSI outlet pressure	8	30 PSI outlet to Port Bruce
Bayham Station: 60-80 PSI outlet pressure	9 + 10	30 PSI outlet to Brownsville
Eden Station: 60-80 PSI outlet pressure	11 + 12	30 PSI outlet to Port Burwell
N. Wallingham Station: 60-80 PSI outlet pressure		

PERFORMANCE PIPE
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DRISCOPLEX® 6500
MDPE PIPE and FITTINGS DATA SHEET

DriscoPlex® 6500 Pipe and Fittings meet or exceed:

ASTM D2513, D2683, D3261
CAN/CSA-B137.4
UPC
ASTM D3350, cell classification PE234373E and PE234375E
PPI TR-4 designations PE2708 (PE2406) and PE80
PPI TN-30

DriscoPlex® 6500 Yellow MDPE Pipe and Fittings for

Natural Gas Distribution, LPG and Propane Gas Distribution, Yard Gas
Iron Pipe Size OD (IPS) ½" to 24",
Copper Tube Size OD (CTS) ½" to 1 ¼"
Coils available up through 6"

Outdoor Storage up to Three (3) Years per ASTM D2513

NOMINAL PIPE PROPERTIES [1]	UNIT	TEST METHOD	VALUE
Density	gms / cm^3	ASTM D1505	0.939 (yellow)
Melt Index (MI) Condition 190°C / 2.16kg	gms / 10 min	ASTM D1238	0.18
Hydrostatic Design Basis 73°F (23°C)	psi	ASTM D2837	1250
Hydrostatic Design Basis 140°F (60°C)	psi	ASTM D2837	1000
Minimum Required Strength	MPa (psi)	ISO 9080	8.0 (116)
Rapid Crack Propagation (Pc) 0°C (32°F) [3]	Bar (psi)	ISO 13478	8.5 (123)
Color; UV Stabilizer [E]	--	ASTM D3350	Yellow; UV stabilized
Pipe Test Category	--	ASTM D2513	CEE
NOMINAL MATERIAL PROPERTIES [1] [2]	**UNIT**	**TEST METHOD**	**VALUE**
Flexural Modulus at 2% secant	psi	ASTM D790	>90,000
Tensile Strength at Yield	psi	ASTM D638 Type IV	2,800
Elongation at Break 2 in / min., Type IV bar	%	ASTM D638	>800
Hardness	Shore D	ASTM D2240	63
PENT	hrs	ASTM F1473	>2,000
Vicat Softening Temperature	°F	ASTM D1525	227
Brittleness Temperature	°F	ASTM D746	< -103

1. This is not a product specification and does not guarantee or establish specific minimum or maximum values or manufacturing tolerances for material or piping products to be supplied.
2. Values obtained from tests of specimens taken from piping product may vary from these typical values.
3. Determination made on 8" DR-11 pipes for Full Scale test. Pc calculated in accordance with ISO 13478.

When Performance Matters Rely on Performance Pipe

Bulletin: PP107 / March 2010

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PERFORMANCE PIPE
A DIVISION OF CHEVRON PHILLIPS CHEMICAL COMPANY LP

DriscoPlex® 6500 Series PE2708 (PE2406) Standard Size and Dimension Sheet

Please visit www.performancepipe.com for the most up-to-date information

NOTE: The sizes and packaging shown represent typical Performance Pipe products. Other sizes and/or packaging may be available. Contact Performance Pipe for additional information. Pipe weights are calculated in accordance with PPI TR-7. Dimensions and weights are subject to change without notice.

CTS = Copper Tube Size

Part Number	Nominal Size (Inches)	Minimum Wall (Inches)	Nominal Outside Diameter (Inches)	Dimension Ratio	MAOP (psig per CFR Part 192 @ 73.4° F or less)	Weight per 100 ft.	Coil/ Joint (feet)	Nominal Packing Dimensions ID/OD/Width	Number Coils/Joints Per Pallet or Bundle	Pallet / Bundle Footage	Number Pallet / Bundles Per Truck	48 ft. Truck
1002425	1/2"	0.090	0.625	7.0	100	6.5	1,000'	30" / 44" / 6"	12	12,000'	26	312,000'
1002445	1"	0.099	1.125	11.5	76	14.0	500'	30" / 42" / 11"	8	4,000'	26	104,000'

IPS = Iron Pipe Size

Part Number	Nominal Size (Inches)	Minimum Wall (Inches)	Nominal Outside Diameter (Inches)	Dimension Ratio	MAOP (psig per CFR Part 192 @ 73.4° F or less)	Weight per 100 ft.	Coil/ Joint (feet)	Nominal Packing Dimensions ID/OD/Width	Number Coils/Joints Per Pallet or Bundle	Pallet / Bundle Footage	Number Pallet / Bundles Per Truck	48 ft. Truck
1002239	3/4"	0.095	1.050	11	80	12	500'	30" / 44" / 10"	7	3,500'	26	91,000'
1002249	1"	0.120	1.315	11	80	19	500'	30" / 44" / 12"	6	3,000'	26	78,000'
1002263	1 1/4"	0.166	1.660	10	89	33	500'	48" / 72" / 7½"	12	6,000'	7	42,000'
1002284	2"	0.216	2.375	11	80	63	500'	52" / 78" / 13"	7	3,500'	7	24,500'
1002323	3"	0.304	3.500	11.5	76	131	40'	soft bundles	50	2,000'	14	28,000'
1002318							500'	70" / 96" / 23¾"	4	2,000'	6	12,000'
1002349	4"	0.391	4.500	11.5	76	217	40'	soft bundles	29	1,160'	14	16,240'
1088779							600'	70" / 93" / 49½"	upright		12	7,200'
1010590							1,000'	84" / 116" / 49"	upright		8 coils	8,000'
1002367	6"	0.576	6.625	11.5	76	471	40'	soft bundles	13	520'	14	7,280'
1002363							500'	84" / 120" / 50"	upright		8 coils	4,000'
1002373		0.491		13.5	64	407	40'	soft bundles	13	520'	14	7,280'
1002368							500'	84" / 120" / 50"	upright		8 coils	4,000'
1002384	8"	0.750	8.625	11.5	76	798	40'	soft bundles	9	360'	10	3,600'
1071013		0.639		13.5	64	690						
1007003	12"	0.944	12.750	13.5	64	1507	40'	bulk packs	8 jts/layer	320'	6	1,920'

NOTE: The August revision was strictly for ease in reading columns for minimum wall and DR. No specific data was changed.

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DRISCOPLEX® 6500
MODEL SPECIFICATION

The user may choose to adopt part or all of this Model Specification; however, the user should ensure that all parts used are appropriate for the user's purpose. See notice below.

1 General Terms and Conditions

1.1 Scope. This specification covers requirements for DriscoPlex® 6500 PE2708 (PE2406) polyethylene pipe and fittings for underground gas distribution systems. All work shall be performed in accordance with these specifications.

1.2 Engineered and Approved Plans. Underground gas distribution piping construction shall be performed in accordance with engineered construction plans for the work prepared under the direction of a Professional Engineer. Plans shall conform to the standards and regulations for gas distribution piping. Pipe, fittings, and the installation shall meet the applicable requirements of the U. S. Department of Transportation, Pipeline Safety Regulations, Title 49, Code of Federal Regulations, and Part 192. Private systems shall meet relevant requirements of NFPA 54/ANSI Z223.1, or NFPA 58, or ASME B31.8.

1.3 Referenced Standards. Where all or part of a Federal, ASTM, ANSI, NFPA, etc., standard specification is incorporated by reference in these Specifications, the reference standard shall be the latest edition and revision.

1.4 Licenses and Permits. A licensed and bonded Contractor shall perform all underground gas distribution piping construction work. The Contractor shall secure all necessary permits before commencing construction.

1.5 Inspections. All work shall be inspected by an Authorized Representative of the Owner or Operator who shall have the authority to halt construction if, in his opinion, these specifications or standard construction practices are not being followed. Whenever any portion of these specifications is violated, the Project Engineer or his Authorized Representative shall, by written notice, order further construction to cease until all deficiencies are corrected. A copy of the order shall be filed with the Contractor's license application for future review. If the deficiencies are not corrected, performance shall be required of the Contractor's surety.

2 Polyethylene Pipe and Fittings

2.1 Qualification of Manufacturers. The Manufacturer shall have manufacturing and quality control facilities that are capable of producing and assuring the quality of the pipe and fittings required by these Specifications. The Manufacturer's production facilities shall be open for inspection by the Customer or his Authorized Representative. The pipe and fitting manufacturer shall be ISO Certified in accordance with the current edition of ISO 9001 and a documented quality management system that defines product specifications and manufacturing and quality assurance procedures that assure conformance with customer and applicable regulatory requirements. Upon request, the manufacturer shall provide a current Certificate of Compliance form and independent ISO 9000 Registrar.

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2.2 Approved Manufacturers. Manufacturers that are qualified and approved by the Project Engineer are listed below. Products from unapproved manufacturers are prohibited. Performance Pipe, a division of Chevron Phillips Chemical Company LP

2.3 Materials. Materials used for the manufacture of polyethylene pipe and fittings shall be PE 2708 (PE2406) medium density polyethylene meeting cell classification 234373E per ASTM D 3350; and shall be Listed in PPI (Plastics Pipe Institute) TR-4 with standard grade HDB ratings of 1250 psi at 73°F, and 1000 psi at 140°F. All pipe and fittings materials shall be opaque yellow in color. Materials shall be stabilized against ultraviolet deterioration and shall be suitable for unprotected outdoor storage for at least four (4) years.

2.4 Polyethylene Pipe. Pipe shall be DriscoPlex® 6500 PE 2708 (PE2406) polyethylene pipe, and shall be manufactured and tested in accordance with the latest published edition of ASTM D 2513.

2.5 Polyethylene Fittings. Polyethylene heat fusion fittings shall be manufactured and tested by the pipe manufacturer in accordance with ASTM D 2513 and D.O.T. requirements.

2.6 Manufacturer's Quality Control. The pipe and fitting manufacturer shall have an established quality control program responsible for inspecting incoming and outgoing materials. Incoming polyethylene materials shall be inspected for density, melt flow rate, UV protection and contamination. The supplier shall certify the cell classification properties of incoming material. Incoming materials shall be approved by Quality Control before processing into finished goods.

2.6.1 Outgoing materials shall be checked for diameter, wall thickness, roundness, concentricity, toe-in, inside and outside surface finish, markings, and end cut. Quality control shall verify production checks, and test for density, melt flow rate, hoop tensile strength and ductility. X-ray inspection procedures shall be used to inspect molded fittings for voids, and knit line strength shall be tested. All fabricated fittings shall be inspected for joint quality and alignment. Representative tests to verify long-term performance shall include slow crack growth, pipe inside surface ductility, and ambient and elevated temperature sustained pressure testing.

2.6.2 Permanent Records. The Manufacturer shall maintain records of manufacturing location, pipe production and resin lots for at least 50 years.

2.7 Compliance Tests. The Manufacturer shall certify the inspection and testing of the materials and products. In case of conflict with Manufacturer's certifications, the Contractor, Project Engineer, or Operator may request retesting by the Manufacturer or have retests performed by an outside testing service. All retesting shall be at the requestor's expense, and shall be performed in accordance with the Specifications.

3 Joining

3.1 Heat Fusion Joining. Butt, socket, and saddle fusion joints in polyethylene gas piping shall be made using procedures that have been qualified and approved by the Operator in accordance with Title 49, CFR, and Part 192.283.

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MODEL SPECIFICATION

3.1.1 In accordance with CFR. 49, part 192, Section 192.285, the Operator shall ensure that all persons making heat fusion joints have been qualified to make joints in accordance with the Operator's Approved Qualified Fusion Procedures. The Operator shall maintain records of qualified personnel, and shall certify that qualification training was received not more than 12 months before commencing construction. The Contractor shall ensure that all persons making heat fusion joints are qualified in accordance with this section.

3.1.2 The Manufacturer shall offer qualified fusion procedures and training materials for the use of the Operator.

3.1.3 Butt Fusion of Unlike Wall Thickness. Butt fusion shall be performed between pipe ends, or pipe ends and fitting outlets that have the same outside diameter and are not different in wall thickness by more than one Standard DR, for example, SDR 9 (9.3, 9.33) to SDR 11 (11.5), or SDR 11 (11.5) to SDR 13.5. Transitions between unlike wall thickness greater than one SDR shall be made with a transition nipple (a short length of the heavier wall pipe with one end machined to the lighter wall) or by mechanical means or electrofusion. Standard DR's for polyethylene pipe are 7.3, 9, 11, 13.5, 17 and 21.

3.2 Joining by Other Means. Polyethylene gas pipe and fittings may be joined together or to other materials by transition fittings, fully restrained mechanical couplings, or electrofusion. These devices shall be designed for joining polyethylene to another material and shall be approved by the Operator for use in his gas distribution system. When joining by other means, the installation instructions of the joining device manufacturer shall be observed.

3.2.1 When mechanical OD compression couplings are used, polyethylene gas pipe shall be reinforced with a stiffener in the pipe bore. Stiffeners shall be properly sized for the diameter and wall thickness of polyethylene pipe being joined. For service pipe connections, the stiffener length shall match the pipe end penetration depth into the coupling.

4 Installation

4.1 General. Polyethylene gas distribution piping shall be installed be in accordance with CFR 49, Part 192, Subpart G (mains), Subpart H (service lines), applicable codes and regulations and ASTM D 2774.

4.1.1 When delivered, a receiving inspection shall be performed, and any shipping damage shall be reported to the Manufacturer within 7 days.

4.2 Burial Depth. All polyethylene gas distribution piping shall be installed in accordance with applicable federal, state and local codes and shall have at least 12" of cover in private property, and at least 18 inches of cover in streets and roads.

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4.3 Excavation. Trench excavations shall conform to the plans and drawings, as otherwise authorized in writing by the Project Engineer or his Approved Representative, and in accordance with all applicable codes. The Contractor shall remove excess groundwater. Where necessary, trench walls shall be shored or reinforced, and all necessary precautions shall be taken to ensure a safe working environment.

4.4 Foundation & Bedding. Pipe shall be laid on grade and on a stable foundation. Unstable trench bottom soils shall be removed, and a 6" foundation or bedding of compacted Class I material shall be installed to pipe bottom grade. A trench cut in rock or stony soil shall be excavated to 6" below pipe bottom grade, and brought back to grade with compacted Class I bedding. All ledge rock, boulders and large stones shall be removed.

4.5 Pipe Handling. Pipe shall be handled in a safe manner that avoids damage to the product. When lifting with slings, only wide fabric choker slings capable of safely carrying the load, shall be used to lift, move, or lower pipe and fittings. Wire rope or chain shall not be used. Slings shall be of sufficient capacity for the load and shall be inspected before use. Worn or damaged equipment shall not be used.

4.6 Backfilling. Embedment material soil type and particle size shall be in accordance with ASTM D 2774. Embedment shall be placed and compacted to at least 90% Standard Proctor Density in 6" lifts to at least 6" above the pipe crown. During embedment placement and compaction, care shall be taken to ensure that the haunch areas below the pipe springline are completely filled and free of voids.

4.7 Protection against shear and bending loads. In accordance with ASTM D 2774, connections shall be protected where an underground polyethylene branch or service pipe is joined to a branch fitting such as a service saddle, branch saddle or tapping tee on a main pipe, and where pipes enter or exit casings or walls. The area surrounding the connection shall be embedded in properly placed, compacted backfill, preferably in combination with a protective sleeve or other mechanical structural support to protect the polyethylene pipe against shear and bending loads.

4.8 Final Backfilling. Final backfill shall be placed and compacted to finished grade. Native soils may be used provided the soil is free of debris, stones, boulders, clumps, frozen clods or the like larger than 8" in their largest dimension.

5 Testing

5.1 Fusion Quality. The Contractor shall ensure the field set-up and operation of the fusion equipment, and the fusion procedure used by the Contractor's fusion operator while on site. Upon request by the Owner, the Contractor shall verify field fusion quality by making and testing a trial fusion. The trial fusion shall be allowed to cool completely; then test straps shall be cut out and bent strap tested in accordance with ASTM D 2657. If the bent strap test of the trial fusion fails at the joint, the field fusions represented by the trial fusion shall be rejected. The Contractor at his expense shall make all necessary corrections to equipment, set-up, operation and fusion procedure, and shall re-make the rejected fusions.

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5.2 Leak Testing. Leak testing shall be conducted in accordance with Performance Pipe Technical Note 802 *Leak Testing.*

5.2.1 Polyethylene gas distribution systems that are subject to D.O.T. Pipeline Safety Regulations shall be tested in accordance CFR 49, Part 192, Sections 192.509, 192.511, or 192.513 as applicable.

5.2.2 The Contractor shall take all precautions to eliminate hazards to persons near lines being tested. Pipes being tested shall be supervised at all times.

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Huddleston, Alex

From: Brian Lippold [brian@nrgas.on.ca]
Sent: November 20, 2014 12:52 PM
To: Huddleston, Alex
Cc: lomeara@cpirentals.com; Mark McCord
Subject: RE: SNC Lavalin Study

Okay Alex, Go ahead and use 2400 M3 on the high side. 2009 on the average or even low side.

Thanks,

Brian

From: Mark McCord
Sent: November-20-14 2:40 PM
To: Brian Lippold
Cc: Huddleston, Alex; lomeara@cpirentals.com
Subject: Re: SNC Lavalin Study

Ya, that sounds like a fair assessment to me.

Mark

On Nov 20, 2014, at 2:07 PM, Brian Lippold <brian@nrgas.on.ca> wrote:

1. should we use the 2009 m^3/year as the normal average flow rate and some higher flow rate, say 2300 m^3/year, as the coldest day of the year flow rate?

The question was really should we do this with a high and a normal flow rate (household consumption). Last year, we were 29% colder in the 4 traditional winter months. It stands to reason that the average home would be about 350 m3 on a normal winter month. So for assumption purposes, I used the 4 consumption months x 350 x 1.29 (29% above the avg. year) to get 1820 for those cold months. I then added the 609 for the remaining 8 months. That gave me 2429m3/year. So if Alex used 2400 as an extreme years flow that would be safe. Do you agree with that loose analysis?

From: Mark McCord
Sent: November-20-14 12:41 PM
To: Brian Lippold
Cc: Huddleston, Alex; lomeara@cpirentals.com
Subject: Re: SNC Lavalin Study

Which question are you referring to?

Mark

On Nov 20, 2014, at 12:22 PM, Brian Lippold <brian@nrgas.on.ca> wrote:

> We can run the report for the schools and government buildings as they are under DP accounts. We would really don't have any large consuming department stores of significance.
>
> 2009 cubic meters is what is still listed as the average house by CMHC and the OEB. People put more appliances in today but they are more efficient than ever. I think Alex was good with that number but there was a question about psi that might be a challenge to answer.
>
> Sent from my iPhone
>
> On Nov 20, 2014, at 11:59 AM, Mark McCord <mmccord@nrgas.on.ca> wrote:
>
>> 1. I am not sure what to use for a residential load. I have never looked at the average total volume for a residential dwelling.
>> 2. We have many customers, my guess would be hundreds that impact the system when they run. Schools, manufacturing, stores and many others. We do not separate most of these from our residential accounts. We would have total annual volumes for these places, but really no way to develop a list. Also, we would have to check billing volumes for these places to determine what time of year their greatest load is. Our billing department may be able to put a list together of the customers with the most consumption in say the month of January or February. We could start there, but we would need volume parameters to develop that.
>>
>> 3. I believe Brian answered this.
>>
>> Thanks
>> Mark

On Nov 20, 2014, at 10:36 AM, Brian Lippold <brian@nrgas.on.ca> wrote:

Mark, I need your thoughts and comments on this as soon as possible to keep Alex going. Please reply all.

Alex, Each of those small villages are less than 150 homes. You can count them but they are not large factors. They are also not very concentrated. You can certainly add them if the load total is significant to you.

Thanks,

Brian

From: Huddleston, Alex [mailto:Alex.Huddleston@snclavalin.com]
Sent: November-20-14 10:01 AM
To: Brian Lippold
Cc: lomeara@cpirentals.com; Mark McCord
Subject: RE: SNC Lavalin Study

Brian,

I was out of the office for a couple of weeks (surgery) and have just returned to work. I need a few more clarifications for the study:

1. Can we use 1900 m^3/year as the normal winter day flow rate and 2100 m^3/year as the extreme flow rate during the coldest day of the year when your system is at its limits –or– should we use the 2009 m^3/year as the normal average flow rate and some higher flow rate, say 2300 m^3/year, as the coldest day of the year flow rate?
2. A critical heating load is any load that impacts the system that isn't already accounted for in the above rates (school, hospital, factory, greenhouses, etc)
3. We've identified 3 other population centers that don't have dwelling counts: Brownsville, Vienna, and Straffordville. Can you please provide the number of dwellings at these

locations or can we exclude them from this study?

We are planning to model the pipeline system at two snapshots in time:

- During a normal winter day when the system can provide gas to all of your customers
- During the coldest winter day when the system is pushed to its limits and may not be able to provide gas to all customers

Comparing these two snapshots we can determine where changes need to be made to the system to allow the gas to get where it needs to go. To create these snapshots, we need to include the flow rate of all gas coming into the system—which you've provided. And we also need to include the flow rate of all gas taken out of the system. Since home heating is the single largest load on the system we've concentrated on it, but we also need to include any other large loads in the system.

Thanks,

Alex Huddleston
Department Manager, Pipelines
Oil & Gas

Tel.: +1 403-294-2714
Cell.: +1 403-461-1102

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605 - 5th Avenue SW, 14th Floor
Calgary | Alberta | Canada | T2P 3H5
<image001.jpg>

<image002.jpg>

From: Brian Lippold [mailto:brian@nrgas.on.ca]
Sent: November 6, 2014 8:06 AM
To: Huddleston, Alex
Cc: lomeara@cpirentals.com; Mark McCord
Subject: SNC Lavalin Study

Hi Alex,

Mark and I have added comments to keep you moving forward. Please see the comments in Red and specific residential data that I have provided at bottom. We would not have gas at every home but safe to say 95% in core areas.

On Nov 4, 2014, at 11:12 AM, Brian Lippold <brian@nrgas.on.ca> wrote:

> We agreed to an earlier set of assumptions.
>
> There appears to be some additional analysis required. Can you please look at what you can answer and I'll pull the meter data by book in the most major centres like Aylmer, Belmont, Port Burwell. Can you identify those locations on Mercury's or P accounts on the map. I.e. the college, the major dryers, et cetera.
>
> Do you also agree with the additional assumptions?
>
> - Assume that the gas demand for each house is identical, so we only need to establish a single representative flow rate to a house for the two scenarios we'll study
>   - It would range from 1900 M3/year to 2100 M3/year from bungalow to 2 story house. 2009 is the number that we can use to get the practical average
> - the normal winter day
>
> That is an Environment Canada question but Degree days are entered into our billing system

so we'd have a history. I don't know of a formula to determine and average day

- the coldest day of the coldest year

it was -27 before wind chill one night in February this year and that apparently broke the record

- Assume that the gas flow to each house can be modeled as a constant flow rate; we won't model the on-off cycling of a gas furnace –Nothing is constant. Thermostats determine peak times i.e. Morning 5-7 am heat-up and 4-7pm heat-up
- Only model the main pipelines; the pipelines within the towns can be excluded- That should be fine
- Use a single take-off for each town (consisting of the number of homes in the town times the representative flow rate) That would work, but we don't have customer counts for some of the towns, like aylmer, port burwell. The billing books do not start and stop by town, only area.
- Other critical heating loads (schools, hospitals, etc.) can be some number of the representative flow rates At what level makes it a critical hearing load? Most customers we have monthly volumes for, but nothing else. We have daily volumes for our large customers, but there are many other customers that make an impact on our system
- Take-offs from the main pipelines will also be modeled as a single take-off (again consisting of the number of

homes and other critical heating loads on the main pipeline times the representative flow rates)Sounds fine

Population Centres in the Area:

Belmont:555
Residential homes
Aylmer: 2030
Residential Homes
Port Burwell: 319
Residential Homes
Port Bruce: Malahide
(township): 6255
Homes include Port
Bruce but estimate 150
Year round dwellings
South Dorchester
(township):Nilestown
100 Dwellings
Springfield (village):
235

From: Huddleston, Alex
[mailto:Alex.Huddleston@snclavalin.com]
Sent: November-04-14 9:12 AM
To: Brian Lippold
Cc: Martyn, Bradley; Mark McCord; lomeara@cpirentals.com
Subject: RE: SNC Lavalin Study

Brian,

Sorry, I should have followed up on my previous email sooner. We need your agreement that the assumptions I've highlighted in green below are reasonable for your system and we're expecting you to provide the data I've highlighted in yellow below.

Thanks,

Alex Huddleston
Department Manager, Pipelines
Oil & Gas

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Cell.: +1 403-461-1102

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<image001.jpg>

<image002.jpg>

From: Brian Lippold [mailto:brian@nrgas.on.ca]
Sent: November 3, 2014 6:24 PM
To: Huddleston, Alex
Cc: Martyn, Bradley; Pakravesh, Hallas; Mark McCord; lomeara@cpirentals.com
Subject: SNC Lavalin Study

Hi Alex,

I am just following up to see how this is coming.

Can you please provide an update and let me know if you are having any challenges that I might assist you with.

Thanks,

Brian Lippold,
General Manager
Natural Resources Gas Ltd.
39 Beech St. E. | Aylmer, ON N5H 3J6
P: 519 773 5321 ext 205 | F: 519 773-5335
Mail to : brian@nrgas.on.ca

<image003.jpg>

From: Huddleston, Alex [mailto:Alex.Huddleston@snclavalin.com]
Sent: October-09-14 9:22 AM
To: Brian Lippold; Mark McCord

Cc: Martyn, Bradley; Pakravesh, Hallas
Subject: RE: Queries and Assumptions

Thanks for the information you provided during our teleconference. I believe I have a better understanding of the issues and complexities of the NRG system.

The main issue is that on the peak demand days the system is getting very close to its capacity and risks not being able to provide gas to customers in certain locations. This usually occurs during the coldest winter days, when the bulk of the gas demand is for heating homes. There are other large gas demands in the system, but they either aren't running during the coldest winter days or can be shutdown when a cold front is forecast.

Based on this I believe that the best path forward is to develop a model of the system for a normal winter day and then simulate what happens to the system when a cold front moves into the area. Using the normal winter day as the starting point establishes the line pack in the system, which is then depleted when as cold front arrives and the gas demand spikes. To do this we'll need representative gas flow rate data for a normal cold winter day and representative gas flow rate data for the coldest day of the coldest year.

I know this sounds like a lot of data, but we can reduce the amount of data required by making the following assumptions:

- Assume that the gas demand for each house is identical, so we only need to establish a single representative flow rate to a house for the two scenarios we'll study:
    - the normal winter day
    - the coldest day of the coldest year

- Assume that the gas flow to each house can be modeled as a constant flow rate; we won't model the on-off cycling of a gas furnace
- Only model the main pipelines; the pipelines within the towns can be excluded
- Use a single take-off for each town (consisting of the number of homes in the town times the representative flow rate)
- Other critical heating loads (schools, hospitals, etc) can be some number of the representative flow rates
- Take-offs from the main pipelines will also be modeled as a single take-off (again consisting of the number of homes and other critical heating loads on the main pipeline times the representative flow rates)

To make this work we'll need the following information:

- A normal winter day constant gas flow rate for a single house (an average flow rate on a normal winter day,)
- A coldest day of the coldest year constant gas flow rate for a single house (the worst case or peak flow rate on the coldest day of the coldest year)
- Number of households in each town
- Number of large heating loads in each town
- Location of any large heating loads not in a town
- Pressure regulator set-point at each house

Working together we'll tune the model varying (or adding and removing) gas take-offs until we achieve a steady state result that matches your experience running the system for the two scenarios.

Please review the above and provide your
comments.

Thanks,

Alex Huddleston
Department Manager, Pipelines
Oil & Gas

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Cell.: +1 403-461-1102

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Calgary | Alberta | Canada | T2P 3H5
<image001.jpg>

<image004.jpg> <image005.jpg>

From: Brian Lippold [mailto:brian@nrgas.on.ca]
Sent: September 25, 2014 1:20 PM
To: Mark McCord
Cc: Huddleston, Alex
Subject: RE: Queries and Assumptions

The dwg is the updated map from Bruckie. The base map that provided was a pdf; I should have been more clear to Alex that the PDF was an illustration of station locations only. Can you please look at Alex's comments below and see if we can help them get to the starting point.

I agree with their assumptions.

I am going to call Alex directly to see if we can help get them closer.

From: Huddleston, Alex [mailto:Alex.Huddleston@snclavalin.com]
Sent: September-11-14 5:30 PM
To: Brian Lippold

Cc: laurie.omeara@cpirentals.com
Subject: Queries and Assumptions

Hi Brian,

After reviewing the data you've provided and beginning to build the model, we have the following questions. Your answers to these questions may prompt other questions:

1. To model the pipeline system we need to know the inputs into the system and the deliveries from the system. You've provided us the input into the system (Harrietsville, Putnam, Eden, Bayham, etc), but we still need the deliveries from the system. To simplify the amount of data required, you can provide a single amount at the end of each pipe that is the total maximum flow rate out of the pipeline. If that is still too much data to collect, we can exclude certain laterals, and have even larger flow rates further upstream of the excluded laterals. We also need the flow rates to Belmont (2 locations), Aylmer, Port Bruce, Brownsville, Port Burwell, and Nilestown
2. There are a number of discrepancies between the system map and the dwg files, especially in the Putnam area. Laterals shown in the dwg files don't appear on the system map and vice-versa. Which source should we assume is correct (system map or dwg files)?

Assumptions:

1. The dedicated 6" line IGPC is excluded from the scope of this study

2. Gas temperature is the same temperature as the ground (0°C in winter and 10°C in summer)
3. Burial depth is 20"
4. All valves shown on the system map of the .dwg files are open
5. Elevation doesn't have a large effect on gas flow, so we'll assume that the elevation profile is flat

Thanks,

Alex Huddleston
Department Manager, Pipelines
Oil & Gas

Tel.: +1 403-294-2714
Cell.: +1 403-461-1102

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Calgary | Alberta | Canada | T2P 3H5
<image001.jpg>

<image004.jpg> <image005.jpg>

From: Brian Lippold [mailto:brian@nrgas.on.ca]
Sent: September 11, 2014 1:13 PM
To: Huddleston, Alex
Cc: laurie.omeara@cpirentals.com
Subject: follow-up
Importance: High

Hi Alex,

I was just following up on the emails that I have sent over the past 5 weeks. I have not received any response.

The Executive and I are looking to move this process forward. We are hoping that you can arrange a time to discuss via conference call or provide a detailed response to my earlier emails.

Thanks,

Brian Lippold,
General Manager
Natural Resources Gas Ltd.
39 Beech St. E. | Aylmer, ON N5H 3J6
P: 519 773 5321 ext 205 | F: 519 773-5335
Mail to : brian@nrgas.on.ca

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NATURAL RESOURCE GAS LIMITED
DIRECT PURCHASE TWELVE MONTH VOLUME REPORT (Cu M)
CONTRACT NUMBER: ENER001
REPORT DATE: 11/21/2014

ACCOUNT # NAME	OCT/14 APR/14	SEP/14 MAR/14	AUG/14 FEB/14	JUL/14 JAN/14	JUN/14 DEC/13	MAY/14 NOV/13	TOTAL
A00199-01 TOWN OF AYLMER (PAC)	121.1	2.8	.0	.0	47.9	414.2	
	1346.7	1955.3	2276.5	2011.6	1512.9	648.0	10337.0
A12596-01 TOWN OF AYLMER (PAC)	10666.7	11976.8	8373.3	7916.9	9229.8	12351.5	
	17248.1	18442.7	22291.3	23195.6	16402.9	15408.4	173504.0
B14610-01 CORP OF TOWN OF AYLMER (PAC)	11.3	33.8	157.8	143.7	.0	.0	
	.0	.0	.0	.0	.0	.0	346.6
B14620-01 TOWN OF AYLMER PUBLIC WORKS DEPT	2.8	2.8	2.8	.0	5.6	67.6	
	352.2	571.9	1459.4	1110.1	712.8	152.1	4440.1
B21899-02 AYLMER POLICE SERVICES (PAC)	250.7	90.2	70.4	90.2	93.0	540.9	
	980.5	1656.6	1907.4	1665.1	1329.8	743.8	9418.6
C00100-01 CORP OF TOWN OF AYLMER (PAC)	42.3	45.1	47.9	42.3	42.3	78.9	
	309.9	864.9	1169.2	879.0	639.5	76.1	4237.4
C17000-01 LCBO	400.1	121.1	25.4	14.1	160.6	831.1	
	1507.3	2454.0	2921.6	2411.7	1952.5	1248.1	14047.6
D07610-01 TOWNSHIP OF MALAHIDE AYLMER	73.3	25.4	36.6	19.7	31.0	135.2	
	445.1	718.4	935.4	845.2	518.4	340.9	4124.6
D49528-01 TOWN OF AYLMER (PAC)	374.7	59.2	36.6	31.0	84.5	825.5	
	2755.4	4626.2	5251.6	5198.1	3003.3	1639.7	23885.8
G05800-01 LCBO	76.1	33.8	.0	8.5	19.7	225.4	
	524.0	755.1	890.3	901.6	670.5	484.6	4589.6
H00101-01 MALAHIDE TOWNSHIP SPRINGFIELD	2.8	.0	.0	2.8	14.1	143.7	
	504.3	662.1	780.4	583.2	301.5	50.7	3045.6
H05820-01 TOWNSHIP OF MALAHIDE SPRINGFIELD	31.0	8.5	11.3	5.6	5.6	8.5	
	14.1	28.2	14.1	39.4	11.3	14.1	191.7
H31000-01 TOWNSHIP MALAHIDE SPRINGFIELD	56.3	19.7	36.6	19.7	28.2	253.6	
	755.1	1141.0	1211.5	1279.1	608.6	205.7	5615.1
H33801-02 TOWNSHIP OF MALAHIDE SPRINGFIELD	211.3	290.2	301.5	357.8	453.6	1324.2	
	3614.7	5099.5	5927.8	4958.6	2814.6	1127.0	26480.8
H48060-03 TOWNSHIP OF MALAHIDE SOUTH DORCHESTER (LYONS)	56.3	33.8	42.3	67.6	397.3	853.7	
	1631.3	1938.4	2639.9	2465.2	1290.4	729.7	12145.9
H48061-01 TOWNSHIP OF MALAHIDE LYONS	28.2	39.4	42.3	56.3	36.6	253.6	
	1265.0	1611.6	2634.3	2053.9	622.6	202.9	8846.7
I34092-01 TOWNSHIP OF MALAHIDE AYLMER	118.3	62.0	36.6	33.8	76.1	1112.9	
	2518.8	3730.2	5772.9	4837.5	2586.4	977.6	21863.1
M10180-01 LCBO	2.8	.0	.0	.0	.0	84.5	
	377.5	614.2	873.4	794.5	400.1	143.7	3290.7
M10190-01 BELMONT PUBLIC LIBRARY	5.6	.0	.0	.0	5.6	59.2	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

NATURAL RESOURCE GAS LIMITED

DATE: 10/31/2014

GAS/CUSTOMER ANALYSIS
AS OF SEP/14

MONTHLY FIGURES									YEAR TO DATE FIGURES							
GAS VOLUME IN M3				NUMBER OF CUSTOMERS					GAS VOLUME IN M3				NUMBER OF CUSTOMERS			
SEP/14	SEP/13	CHANGE	%	SEP/14	SEP/13	CHANGE	%		CURRENT	LAST	CHANGE	%	SEP/14	SEPT	CHANGE	%
								SALES								
352992	294334	58658	20	7467	7174	293	4	RESIDENTIA	16088024	13531207	2556817	19	7467	7174	293	4
76323	60208	16115	27	62	59	3	5	IND-RATE 1	1534158	1422336	111822	8	62	59	3	5
36091	28005	8086	29	33	31	2	6	IND-RATE 4	903962	710717	193245	27	33	31	2	6
118641	118951	310-	0	403	385	18	5	COMMERCIAL	4829642	4122306	707336	17	403	385	18	5
899257	865533	33724	4	63	63	0	0	SEASONAL	1955810	1960797	4987-	0	63	63	0	0
60264	55954	4310	8	3	3	0	0	CON-RATE 3	1794655	1636204	158451	10	3	3	0	0
1690	1127	563	50	3	3	0	0	CON-RATE 5	990936	904723	86213	10	3	3	0	0
1545258	1424112	121146	9	8034	7718	316	4	TOTAL SALE	28097187	24288290	3808897	16	8034	7718	316	4
				% THIS	% LAST			DELIVERIES INTO SYSTEM					% THIS	% LAST		
1342434	1277493	64941	5	86	86			WEST GAS	26409678	22440583	3969095	18	91	89		
45698	12256	33442	273	3	1			HEMLOCK	452559	402043	50516	13	2	2		
167973	199894	31921-	16-	11	13			NORFOLK	2103386	2402847	299461-	12-	7	10		
1556105	1489643	66462	4	100	100			TOTAL PURCHAS	28965623	25245473	3720150	15	100	101		
10847 .7 %	65531 4.6 %	54684-	504					GAS LOSS (GAIN)	868436 3.0 %	957183 3.9 %	88747-	10				
2526334	2712282	185948-	7-	0	0	0	0	ETHANOL	31527596	31357510	170086	1	0	0	0	0

SEPARATE SYSTEM (IND. PIPELINE)

DEGREE DAYS

64.7	94.9	30.2	32% WARMER THIS YEAR	ACTUAL	4347.0	3786.7	560.3	15% COLDER THIS YEAR
102.7	102.7			NORMAL	4057.7	4057.7		

(A Degree Day is the average daily temperature below 18 degrees Celsius.)

Definition of rates:

NATURAL RESOURCE GAS LIMITED
DIRECT PURCHASE TWELVE MONTH VOLUME REPORT (Cu M) PAGE: 1
CONTRACT NUMBER: TVDSB01
REPORT DATE: 11/21/2014

ACCOUNT #	NAME	OCT/14 APR/14	SEP/14 MAR/14	AUG/14 FEB/14	JUL/14 JAN/14	JUN/14 DEC/13	MAY/14 NOV/13	TOTAL
	AYLMER							
C39790-01	THAMES VALLEY DISTRICT SCHOOL BO	791.7	149.3	64.8	107.1	1045.3	3566.8	
		5632.0	14419.4	16284.6	14247.6	11531.6	5927.8	73768.0
	AYLMÉ							
D07800-01	THAMES VALLEY DISTRICT SCHOOL BO	983.3	36.6	33.8	36.6	400.1	2014.4	
		5260.1	8187.4	8514.2	9838.4	5741.9	3761.2	44808.0
	STRAFFORDVILLE							
E47800-01	THAMES VALLEY DISTRICT SCHOOL BO	1377.7	174.7	98.6	90.2	132.4	2544.1	
		6029.2	9122.7	12796.6	12951.6	8542.4	5136.1	58996.3
	PORT BURWELL							
G28300-01	THAMES VALLEY DISTRICT SCHOOL BO	712.8	50.7	22.5	28.2	70.4	1104.4	
		3549.9	4834.7	6440.6	6387.0	4113.4	2961.1	30275.7
	SPRINGFIELD							
H22623-01	THAMES VALLEY DISTRICT SCHOOL BO	115.5	16.9	22.5	25.4	419.8	1414.3	
		4181.0	6130.7	8559.3	7539.4	3307.6	1867.9	33600.3
	SOUTH DORCHESTER							
H47925-01	THAMES VALLEY DISTRICT SCHOOL BO	191.6	22.5	16.9	22.5	45.1	2659.6	
		5037.5	6071.5	7437.9	6618.1	3671.1	2665.3	34459.6
	AYLMER (JAFFA)							
I38083-01	THAMES VALLEY BOARD OF EDUCATION	19.7	22.5	22.5	19.7	19.7	231.0	
		442.3	729.7	972.0	890.3	504.3	267.7	4141.4
	AYLMER.							
P10000-01	THAMES VALLEY DISTRICT SCHOOL BO	2442.7	2099.0	2087.7	2160.9	4640.3	26852.6	
		52741.7	56604.4	65138.3	53668.6	37412.2	14737.8	320586.2
	GRAND TOTAL	6635.0	2572.2	2369.3	2490.6	6773.1	40387.2	
		82873.7	106100.5	126143.5	112141.0	74824.5	37324.9	600635.5

M12000-01 BELMONT FIREHALL	19.7	14.1	14.1	11.3	101.4	577.6	
	1400.2	1312.9	1989.1	1752.4	955.1	191.6	8339.5
M33400-01 BELMONT ARENA	890.3	177.5	309.9	211.3	369.1	2518.8	
	7508.4	9339.7	12069.7	10235.6	6333.5	4209.2	54173.0
GRAND TOTAL	13441.7	13036.2	9545.4	9032.6	11202.0	22660.6	
	45272.7	57827.2	73415.9	67592.1	42849.8	28672.8	394549.0

NATURAL RESOURCE GAS LIMITED
DIRECT PURCHASE TWELVE MONTH VOLUME REPORT (Cu M)   PAGE: 1
CONTRACT NUMBER: FIRE004
REPORT DATE: 11/21/2014

ACCOUNT # NAME	OCT/14 APR/14	SEP/14 MAR/14	AUG/14 FEB/14	JUL/14 JAN/14	JUN/14 DEC/13	MAY/14 NOV/13	TOTAL
H52098-01 1064540 ONTARIO INC	.0	2341.3	3262.5	2034.2	1921.5	1752.4	
AYLMER	324.0	425.4	487.4	287.4	2434.2	890.3	16160.6
P30000-01 KINGSMILL GRAINS	1631.3	8142.3	6508.2	.0	619.8	817.0	
HIGH CONSUMER, AYLMER	2859.7	1011.4	2561.0	22573.0	206123.7	77867.3	330714.7
GRAND TOTAL	1631.3	10483.6	9770.7	2034.2	2541.3	2569.4	
	3183.7	1436.8	3048.4	22860.4	208557.9	78757.6	346875.3

NATURAL RESOURCE GAS LIMITED
DIRECT PURCHASE TWELVE MONTH VOLUME REPORT (Cu M) PAGE: 1
CONTRACT NUMBER: CESI001
REPORT DATE: 11/21/2014

ACCOUNT # NAME	OCT/14 APR/14	SEP/14 MAR/14	AUG/14 FEB/14	JUL/14 JAN/14	JUN/14 DEC/13	MAY/14 NOV/13	TOTAL
H04660-02 JOANNE SAARLOOS (PAC)	366.3 338.1	284.6 295.8	239.5 560.7	242.3 521.2	611.4 509.9	281.7 284.6	4536.1
P03000-04 ELGIN FEEDS AYLMER	.0 .0	.0 .0	.0 .0	.0 12402.2	.0 26303.2	.0 14368.7	53074.1
GRAND TOTAL	366.3 338.1	284.6 295.8	239.5 560.7	242.3 12923.4	611.4 26813.1	281.7 14653.3	57610.2

Gas Day of November 12/14

Location	Pressure (PSI)	Type	Description
North Walsingham	83	Union Gas Input into NRG System	
Bayham (New England)	79	Union Gas Input into NRG System	
Putnam Station	81	Union Gas Input into NRG System	
Harrietsville Station	89	Union Gas Input into NRG System	
Eden (Ridge Rd)	83	Union Gas Input into NRG System	
Rogers Rd and Talbot Ln	42	Feeding Town of Aylmer	Feeds east into Aylmer on Talbot Ln at 28psi
Hacienda Rd and Talbot Ln	52	Feeding Town of Aylmer	SE corner Feeding into Aylmer at 28psi
John St S at Bradley Creek	51	Feeding Town of Aylmer	Feeds North into Aylmer on Imperial Rd at 28psi
Beech St	65	Feeding Town of Aylmer	Feeds south into Aylmer on Imperial Rd at 28psi
Belmont South	78	Feeding Town of Belmont	Feeds north into Belmont on Belmont Rd at 35psi
Belmont North	33	Feeding Town of Belmont	Feeds south into Belmont on Belmont Rd at 35psi (drooping to 31)
Port Bruce	53	Feeding Town of Port Bruce	Feeding south to Port Bruce
Brownsville South	38	Feeding Town of Brownsville	NE corner of Hawkins Rd and Culloden Ln, feeding north at 35psi
Vanmoerkerke	63	Customer	Carson Ln, on curve almost to Talbot Ln
YPMA	9	Customer	NW corner of Ostrander Rd and Culloden Ln
Sylvite Avon	55	Customer	North sd of Avon Dr west of Putnam Rd
FS Partners Straffordville	54	Customer	North sd of Jackson Ln East of Plank Rd (south of Straffordville)
Klassen Farms	55	Customer	Regional Rd #28 North of Fairground Rd
Kingsmill Grain	21	Customer	Ron McNeil Ln west of Springwater Rd at the very end of the Main (Large Customer)
Graydon Farms	33	Customer	SE corner of Hawkins Rd and Culloden Ln
Isaak Bartsch	59	Customer	Fairground Rd east of 5th Conc Enr
Best Ln Farms	35	Customer	SE Corner of Best Ln and Somers Rd
Herman	74	Check point	SE corner of Toll Gate Rd and Heritage Ln
Doerksen	60	Check point	NE corner of Regional Rd #23 and Regional Rd #60
Whittaker Rd and Yorke Ln	79	Check point	SW corner of Whittaker Rd and Yorke Ln

Huddleston, Alex

From: Mark McCord [mmccord@nrgas.on.ca]
Sent: January 7, 2015 1:09 PM
To: Huddleston, Alex
Cc: Brian Lippold
Subject: Re: Helpful System info

That was my mistake

North walsingham =walsingham
New England = Bayham
Ridge Rd = Eden

We didn't have pressure reading for belmont and Brownsville.

Thanks
Mark

On Jan 6, 2015, at 4:30 PM, Huddleston, Alex <Alex.Huddleston@snclavalin.com> wrote:

Mark, Brian,

No, I didn't receive the spreadsheet that Mark initially sent on Dec 23rd.

You've used a number of different names for the flow inputs: The GCA report has deliveries into the system at West Gas, Hemlock, and Norfolk, while Mark's pressure data has delivery pressures at North Walsingham, New England, Putnam Station, Harrietsville Station, and Ridge Road, and the initial locations where gas is input into the system are Harrietsville, Putnam, Eden, Bayham, Walsingham, Belmont, and Brownsville. Can you tell us how to correlate this data. We need to have a flow rate and pressure, if available, for each delivery point into the system. I've summarized t in a table below:

GCA Report	Mark's Pressure Spreadsheet	Initial Delivery Point Information
West Gas		
Hemlock		
Norfolk		
	North Walsingham	Walsingham
	New England	
	Putnam Station	Putnam
	Harriestville Station	Harriestville
	Ridge Rd	
		Eden
		Bayham
		Belmont

		Brownsville

Once we resolve this question, we'll input this data into the model and see if it converges. If the model converges, we'll be able to start the analysis, otherwise we'll see what additional data we need.

Thanks,

Alex Huddleston
Department Manager, Pipelines
Oil & Gas

Tel.: +1 403-294-2714
Cell.: +1 403-461-1102

SNC-Lavalin Inc.
605 - 5th Avenue SW, 14th Floor
Calgary | Alberta | Canada | T2P 3H5
<image002.jpg>

<image003.jpg>

From: Mark McCord [mailto:mmccord@nrgas.on.ca]
Sent: January 5, 2015 9:07 AM
To: Huddleston, Alex
Subject: RE: Helpful System info

Alex
Did you get this attachment, I sent you on Dec 23? It has the pressures we experienced on that peak grain drying day.

Thanks

From: Huddleston, Alex [mailto:Alex.Huddleston@snclavalin.com]
Sent: Monday, January 05, 2015 10:17 AM
To: Mark McCord
Cc: 'lomeara@cpirentals.com'; Brian Lippold
Subject: RE: Helpful System info

Mark,

Have you been able to review this email I sent last year?

Thanks,

Alex

From: Huddleston, Alex
Sent: December 17, 2014 5:47 PM
To: Mark McCord
Cc: lomeara@cpirentals.com; Brian Lippold
Subject: RE: Helpful System info

Mark,

My comments below.

Thanks,

Alex

From: Brian Lippold [mailto:brian@nrgas.on.ca]
Sent: December 17, 2014 1:31 PM
To: Huddleston, Alex
Cc: lomeara@cpirentals.com; Mark McCord
Subject: Helpful System info

Alex

So we can best assist you in reaching your end goal we are hoping that you might clarify your approach. The following 2 questions may dig up enough that we can come up with some ideas to move you in a direction of success:

1. Which scenario are you working at modeling?
   - summer
   - winter Winter. I understood that the coldest winter month had the highest demand on the system and that the largest demand from the system was for residential heating. We planned on modeling two flow rates for a typical residence: the normal winter month and the coldest winter month. For a typical residential home you directed us to use 2009 m3/yr for a normal winter flow rate and 2400 m3/yr for the coldest winter month.
   - grain drying (autumn to winter cross-over)
   - peak demand times (residential wake-up and evening)
2. What specific time frames in the above period, are you looking at modeling?
   - Hour
   - day
   - month
   - annual

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Here are some key points and observations. These points were made by Mark McCord. So any clarification that you may require should be directed to him. Please copy me on the responses.

- We observe the time when our system is pushed to its limits occurs in the crossover of winter heating load and grain drying season.

- Grain drying occurs in October and November. OK. Can you please send us a Gas/Customer Analysis report for a worst case month where your system was pushed to its limits. We can use these rates as a starting point to set up the system
- If we experience cold weather during the grain drying, it results in an increase in natural gas consumption

From what I understand, you are trying to simulate our system performance based on various supplies and consumptions throughout our system. With almost 8000 customers, it is difficult to account for the load of each individual customer. We have daily consumption volume figures from our larger customers. For the most part our consumption volumes are taken on a monthly basis and the reading are staggered throughout any given month. We plan to use the normal and coldest day residential flow rates above for the majority of the load, and get volumes from other large customers from the CGA report.

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Is it possible for you to model the system using the pressures taken at various points throughout our system? Yes, please provide pressure readings for a worst case time where your system was pushed to its limits. Most pressures would be instantaneous pressures and some are daily averages. Please identify if the pressure is an average or instantaneous. I could identify where the pressure readings were taken and if it is a customer (an exit of gas) or a pipeline checkpoint. The more pressures you are able to provide the more accurate our model will be. And differentiating between the customers and the checkpoints is critical. Is it possible for the modeling software to then solve for the exit flowrate based on each pressure reading location? Yes, the model can solve for an exit flow rate. We can then use the CGA report (or some other information) for the same time period so that we can check the exit flow rates that the model calculates. During these high demand days, I could also identify the volume of gas purchased into our system on a daily basis at each of the delivery points. Yes, please provide the gas purchases and the location of these purchase for this worst case time period.

I think that using inlet flow rates and line pressures at all end-points and at various locations along the system will be the best approach. I'd like to model two scenarios:

- Before the grain dryers are turned on and the cold snap moves in
- After the grain dryers are turned on and the cold snap moves in

Can you provide pressure readings and flow rates for these two scenarios? We'd also like to compare the flow rates calculated by the model with your records, so please provide a CGA report for these periods or some other record of flow rates if available.

It might be worth a discussion to clarify any points above as we feel it will help move you forward if you are stuck.

Brian Lippold,
General Manager
Natural Resources Gas Ltd.
39 Beech St. E. | Aylmer, ON N5H 3J6
P: 519 773 5321 ext 205 | F: 519 773-5335
Mail to : brian@nrgas.on.ca

Huddleston, Alex

From: Mark McCord [mmccord@nrgas.on.ca]
Sent: January 7, 2015 12:54 PM
To: Huddleston, Alex; Brian Lippold
Subject: RE: Helpful System info

1. That is correct
2. That is correct
3. This regulator can be placed on Imperial Rd, South of Nova Scotia Ln
4. Klassen Farms is on regional rd #28, north of Fairgound Rd. (east Side)
5. Isaak Bartsch is on Fairground Rd East of 5th Conc ENR.

Which regulator stations are you referring to?

Thanks
Mark

From: Huddleston, Alex [mailto:Alex.Huddleston@snclavalin.com]
Sent: Wednesday, January 07, 2015 9:15 AM
To: Mark McCord; Brian Lippold
Subject: RE: Helpful System info

Mark, Brian,

In addition to our questions of yesterday can you please clarify the following:

1. Belmont South – The DWG files do not show a regulator station on the south end of Belmont. We will assume that there is a regulator station here feeding into Belmont.
2. Belmont North – The DWG files do not show a regulator station on the north end of Belmont. We will assume that there is a regulator station here feeding into Belmont.
3. Port Bruce - The DWG files do not show a regulator station near Port Bruce. We do not have a separate DWG file for the Port Bruce & Copenhagen area. Location of this regulator needs to be identified.
4. Klassen Farms – Location could not be found.
5. Isaak Bartsch – Location could not be found.

Can you also provide pressures data for the other gas regulator stations shown in the .DWG files?

Thanks,

Alex Huddleston
Department Manager, Pipelines
Oil & Gas

Tel.: +1 403-294-2714
Cell.: +1 403-461-1102

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605 - 5th Avenue SW, 14th Floor
Calgary | Alberta | Canada | T2P 3H5

SNC • LAVALIN

KENTZ
Engineers & Constructors
Member of the SNC-Lavalin Group

From: Huddleston, Alex
Sent: January 6, 2015 2:29 PM
To: 'Mark McCord'; 'Brian Lippold'
Subject: RE: Helpful System info

Mark, Brian,

No, I didn't receive the spreadsheet that Mark initially sent on Dec 23rd.

You've used a number of different names for the flow inputs: The GCA report has deliveries into the system at West Gas Hemlock, and Norfolk, while Mark's pressure data has delivery pressures at North Walsingham, New England, Putnam Station, Harrietsville Station, and Ridge Road, and the initial locations where gas is input into the system are Harrietsville Putnam, Eden, Bayham, Walsingham, Belmont, and Brownsville. Can you tell us how to correlate this data. We need to have a flow rate and pressure, if available, for each delivery point into the system. I've summarized t in a table below:

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Once we resolve this question, we'll input this data into the model and see if it converges. If the model converges, we'll be able to start the analysis, otherwise we'll see what additional data we need.

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SNC·LAVALIN

KENTZ
Engineers & Constructors
Member of the SNC-Lavalin Group

From: Mark McCord [mailto:mmccord@nrgas.on.ca]
Sent: January 5, 2015 9:07 AM
To: Huddleston, Alex
Subject: RE: Helpful System info

Alex

Did you get this attachment, I sent you on Dec 23? It has the pressures we experienced on that peak grain drying day.

Thanks

From: Huddleston, Alex [mailto:Alex.Huddleston@snclavalin.com]
Sent: Monday, January 05, 2015 10:17 AM
To: Mark McCord
Cc: 'lomeara@cpirentals.com'; Brian Lippold
Subject: RE: Helpful System info

Mark,

Have you been able to review this email I sent last year?

Thanks,

Alex

From: Huddleston, Alex
Sent: December 17, 2014 5:47 PM
To: Mark McCord
Cc: lomeara@cpirentals.com; Brian Lippold
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My comments below.

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Alex

From: Brian Lippold [mailto:brian@nrgas.on.ca]
Sent: December 17, 2014 1:31 PM
To: Huddleston, Alex
Cc: lomeara@cpirentals.com; Mark McCord
Subject: Helpful System info

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Brian Lippold,
General Manager
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P: 519 773 5321 ext 205 | F: 519 773-5335
Mail to : brian@nrgas.on.ca

nRG
Natural Resource Gas Limited

Huddleston, Alex

From: Brian Lippold [brian@nrgas.on.ca]
Sent: January 5, 2015 12:55 PM
To: Huddleston, Alex
Cc: Mark McCord
Subject: RE: Helpful System info
Attachments: NRG Gas Analysis.pdf

Happy New Year.

Please see our Nov Gas Analysis for that peak period in Nov. Mark forwarded some pressure data with specific pressures and corresponding dates. Let's schedule a call and determine how to get the cheese at the end of the maze. When are you available?

Thanks,

Brian Lippold,
General Manager
Natural Resources Gas Ltd.
39 Beech St. E. | Aylmer, ON N5H 3J6
P: 519 773 5321 ext 205 | F: 519 773-5335
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Natural Resource Gas Limited

From: Huddleston, Alex [mailto:Alex.Huddleston@snclavalin.com]
Sent: January-05-15 10:17 AM
To: Mark McCord
Cc: 'lomeara@cpirentals.com'; Brian Lippold
Subject: RE: Helpful System info

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Sent: December 17, 2014 5:47 PM
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Cc: lomeara@cpirentals.com; Brian Lippold
Subject: RE: Helpful System info

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Alex

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Sent: December 17, 2014 1:31 PM
To: Huddleston, Alex
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nRG
Natural Resource Gas Limited

NATURAL RESOURCE GAS LIMITED

DATE: 12/31/2014

GAS/CUSTOMER ANALYSIS
AS OF NOV/14

MONTHLY FIGURES: GAS VOLUME IN M3 NOV/14	NOV/13	CHANGE	%	NUMBER OF CUSTOMERS NOV/14	NOV/13	CHANGE	%		YEAR TO DATE FIGURES: GAS VOLUME IN M3 CURRENT	LAST	CHANGE	%	NUMBER OF CUSTOMERS NOV/14	SEPT	CHANGE	%
								SALES								
1676212	1563487	112725	7	7555	7264	291	4	RESIDENTIA	2513543	2332018	181525	8	7555	7467	88	1
383223	296785	86438	29	62	60	2	3	IND-RATE 1	587259	538095	49164	9	62	62	0	0
626759	355640	271119	76	34	33	1	3	IND-RATE 4	876380	704772	171608	24	34	33	1	3
476309	456982	19327	4	402	391	11	3	COMMERCIAL	710379	681642	28737	4	402	403	1-	0
117063	80662	36401	45	63	63	0	0	SEASONAL	409734	376630	33104	9	63	63	0	0
195105	184173	10932	6	3	3	0	0	CON-RATE 3	302307	278866	23441	8	3	3	0	0
694827	607657	87170	14	3	3	0	0	CON-RATE 5	842515	874126	31611-	4-	3	3	0	0
4169498	3545386	624112	18	8122	7817	305	4	TOTAL SALE	6242117	5786149	455968	8	8122	8034	88	1
				% THIS	% LAST			DELIVERIES INTO SYSTEM					% THIS	% LAST		
4415371	3629458	785913	22	95	94			WEST GAS	6134097	5633558	500539	9	93	92		
45163	64011	18848-	29-	1	2			HEMLOCK	95820	76802	19018	25	1	1		
164311	183131	18820-	10-	4	5			NORFOLK	338313	386434	48121-	12-	5	6		
4624845	3876600	748245	19	100	101			TOTAL PURCHAS	6568230	6096794	471436	8	99	99		
455347 10.9 %	331214 9.3 %	124133	27					GAS LOSS (GAIN)	326113 5.2 %	310645 5.3 %	15468	5				

[redacted]

DEGREE DAYS

503.7	493.3	10.4	2% COLDER THIS YEAR	ACTUAL	741.1	717.4	23.7	3% COLDER THIS YEAR
446.7	446.7			NORMAL	725.6	725.6		

(A Degree Day is the average daily temperature below 18 degrees Celsius.)

Definition of rates:

Huddleston, Alex

From: Huddleston, Alex
Sent: May 5, 2015 9:49 AM
To: Orr, John
Subject: FW: Status Update

From: Brian Lippold [mailto:brian@nrgas.on.ca]
Sent: May 5, 2015 9:47 AM
To: Huddleston, Alex
Cc: Mark McCord
Subject: FW: Status Update

I thought that Mark sent this directly to you the day of our last conversation about the wells and using the Max draw on worst day (highest consumption).

See his data below.

Brian Lippold,
General Manager
Natural Resources Gas Ltd.
39 Beech St. E. | Aylmer, ON N5H 3J6
P: 519 773 5321 ext 205 | F: 519 773-5335
Mail to : brian@nrgas.on.ca

Natural Resource Gas Limited

Alex

Here are the daily volumes at each of the union gas station inputs on Nov 12/14

-Belmont Station – 12509m3
-Harrrietsville Station – 86919m3
-Putnam Station - 38513m3
-Brownsville Station – 1183m3
-Bayham Station – 28962m3
-Eden Station – 28005m3
-North Walsingham Station – 23919m3

The well inputs are as follows

- Nova Scotia Ln Between Richmond Rd and Woodworth Rd – 1888m3/day
- Fairground Rd and Regional Rd #28 – 4888m3/day
- On 2nd Conc ENR North of Barth Sd Rd – 4888m3/day

Lastly the town of Port Burwell is regulated to 30psi. The East side of the town is disconnected at Plank Rd and Teall Neville Ln and the west side is disconnected at Brown Rd and Nova Scotia ln. There is only one pipeline on Vienna Ln that connects the system East of Plank Rd to the System West of Plank Rd.

Thanks
Mark

From: Huddleston, Alex [mailto:Alex.Huddleston@snclavalin.com]
Sent: Tuesday, February 17, 2015 12:19 PM
To: Brian Lippold
Cc: Mark McCord
Subject: Status Update

Hi Brian,

Please see the attached file. Printing it in 11x17 is OK, but please print as large as you can. The file contains a representation of the NRG system in the SPS model based on the pressures you provided for grain drying on Nov 12th, '14.

We've placed a node at each intersection in the network and color coded the node according to its pressure:

- The darker colors show higher pressure
- Green is between 40 and 50 psi
- Yellow is between 30 and 40 psi
- Red is less than 30 psi

The legend on the chart also states the number of nodes in each pressure range

The pressure and flow rate coming in from each station are shown adjacent to the station's location. The total flow into the system is about 7570 m3/hr, which is approximately 20% higher than the highest average monthly rate that we've seen. The flow rates coming into the system are rounded to the nearest 100 on the attached file. We also limited the inlet pressures to 80 psi, which is the MAOP of the pipelines.

We didn't receive a pressure at Brownsville Station so we limited it to 170 m3/hr, which is its maximum hourly volume. We also didn't receive a pressure at Belmont Station, and it's maximum hourly flow is 538 m3/hr, but in the model only 50 m3/hr are required to feed the town of Belmont from the North.

The pressure at each location you supplied are also shown. In most cases, the pressure calculated in the model matches the pressure you provided. The only exceptions are:

- at Beach St., where the model pressure is 5 psi higher than the provided pressure
- at Herman, where the model pressure is 4 psi lower than the provided pressure
- at Issak Bartch, where the model has calculated the equivalent of a 50 m3/hr input into the system—which I believe can be attributed to flow from the local well sites

We've added two loops into the system that are currently inactive in the model: at John Wise and along Wilson between Whitaker and Prigham. The nodes are showing red and yellow respectively in the model.

The main areas of concern (where there are a number of yellow and red nodes) are in the Aylmer region and in the Brownsville region. The next step we'll take is to modify the system to alleviate the low pressure areas by looping or adding laterals. We'll send another chart like the attached showing the system pressures after looping or additional laterals have been added to the system.

The model has been revised to run on inlet and outlet pressures, so if you can provide pressures for other extreme days, that are different from Nov 12th, '14, we can complete a chart like the attached in about 8 hours and it will increase our understanding of the system and how we can alleviate the low pressure areas.

Thanks,

Alex Huddleston
Department Manager, Pipelines
Oil & Gas

Tel.: +1 403-294-2714
Cell.: +1 403-461-1102

SNC-Lavalin Inc.
605 - 5th Avenue SW, 14th Floor
Calgary | Alberta | Canada | T2P 3H5

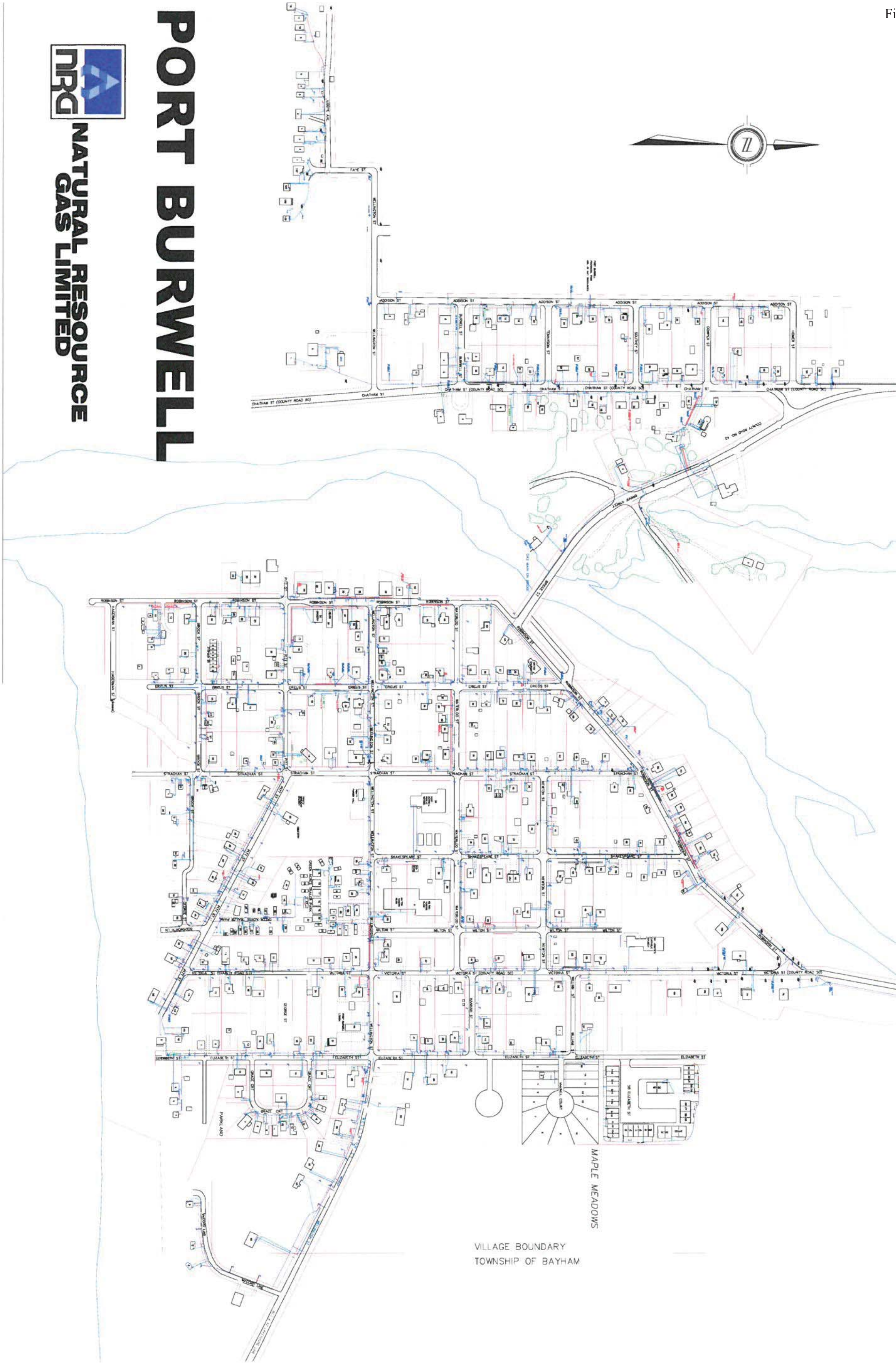
SNC • LAVALIN

KENTZ
Engineers & Constructors
Member of the SNC-Lavalin Group

Contracted Labour and Material Cost Estimates for SW Ontario Market			
Action/Task	Per metre Material Cost	Labour cost Per metre or Hourly	Conditions
Directional Drilling/Boring		\$55/m @4" \$75/m @6"	30" or greater required by a local; Water, sub road; below culvert; inclines/declines of greater than 15 degrees. Protected area; walkways, gardens or areas that require significant restoration
Trenching with sticks (3/4")		\$31.25/m	36" or less below grade; accessible road allowance; grade without considerable slope (0= >15 degrees); only 3 or 4" PE 3", 4" and 6"
Trenching with rolls		\$15/m @2" \$27.50 @3"	1 to 3" OD maximum
Fusing/ Capping	n/a	n/a	Included in installation cost
Marker/ Signage Installation		75/hour	Every valve; High pressure; Road Crossing; 500m min standard
Hot Tapping + Connection	n/a	n/a	Engineered by pipe size- only applicable to the dedicated 6" IGPC steel pipeline
Dry Tapping + Connection			Included in installation costs
Clean, Dry, Pig, Leak Test			Included in installation cost
PE Pipe Pricing	1" 2" 3"Roll 3" Stick 4" 6"	\$ 2.79 \$ 4.92 \$12.00 \$15.00 \$21.00 \$30.00	Contractor requoted pricing –Feb 2016
PE Fittings	n/a	n/a	Various by diameter and function-too broad

1- The projects that have been identified would all be completed using PE (plastic) pipe.
2- That installation of tracer wire is included in all boring or trenching costs
3- All provided material or labour-costs are average prices from within a 36 month period.
4- Hourly or task costs include equipment required
5- No surveying required in our Franchise area

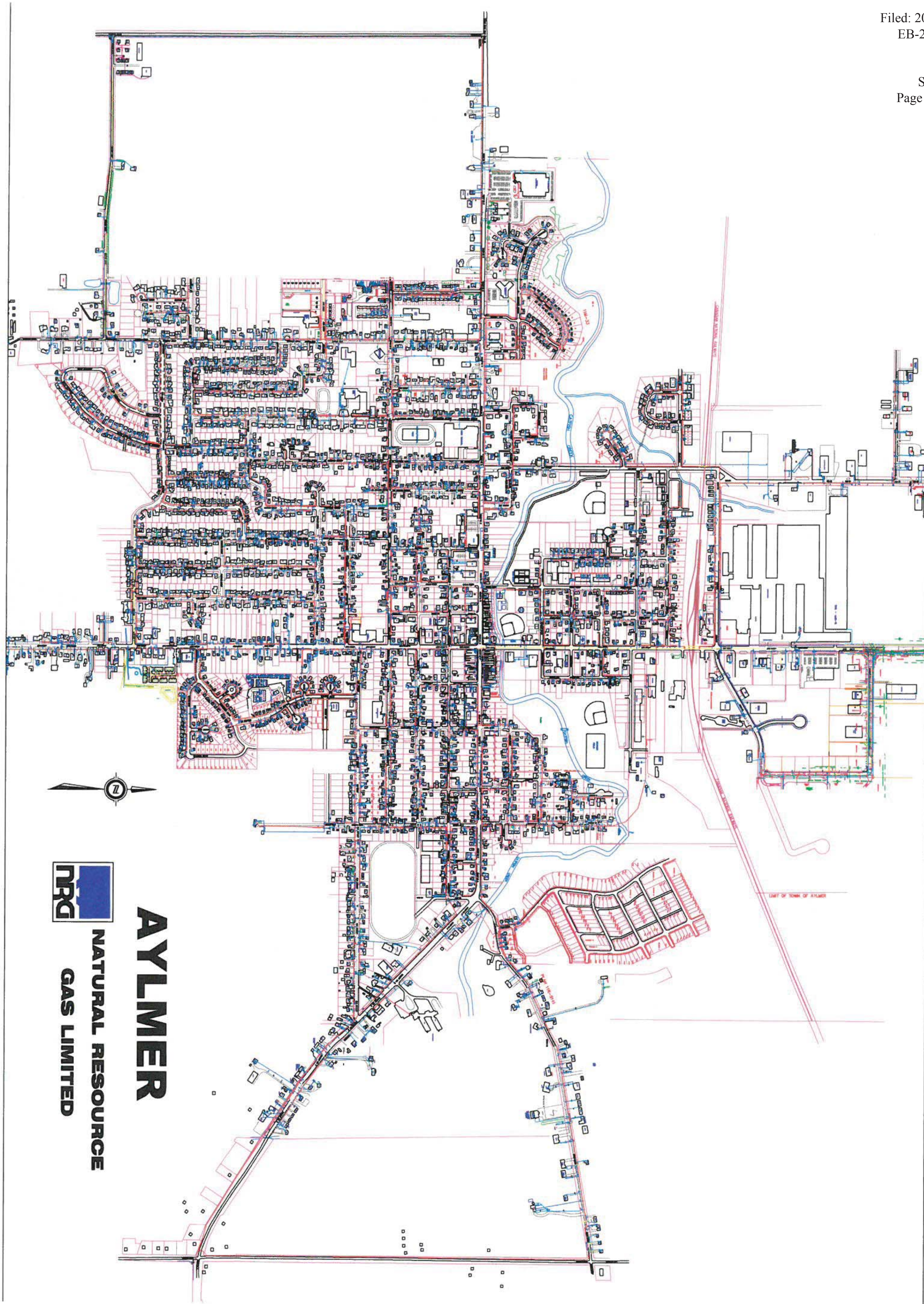

LAKE ERIE


PORT BURWELL
NATURAL RESOURCE GAS LIMITED
MAPLE MEADOWS
VILLAGE BOUNDARY
TOWNSHIP OF BAYHAM

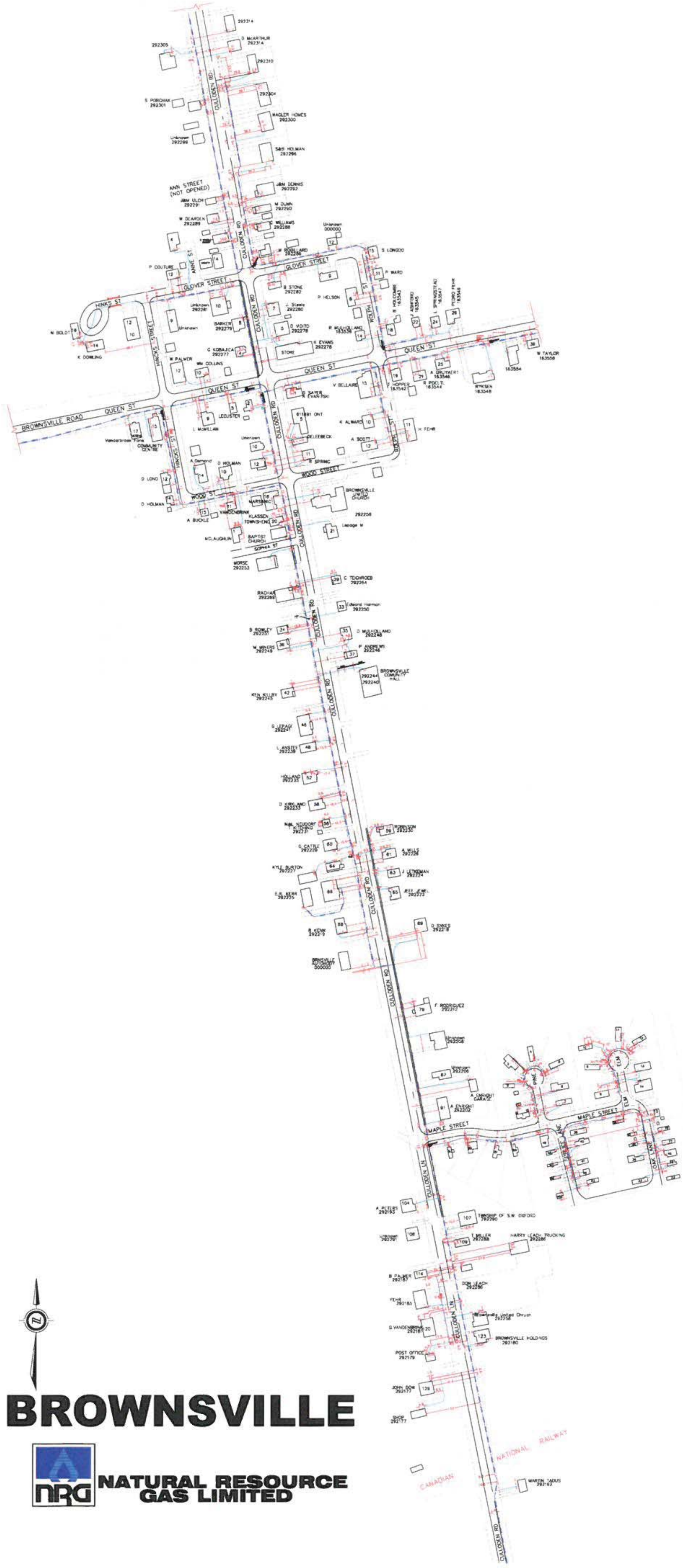

SPRINGFIELD
NRG
NATURAL RESOURCE
GAS LIMITED
CONC. X
LOT 22
CONC. XII
LOT 5
CONC. X
LOT 23
CONC. XII
LOT 4
CONC. X
LOT 24
CONC. XII
LOT 3


STRAFFORDVILLE
NRG
NATURAL RESOURCE
GAS LIMITED

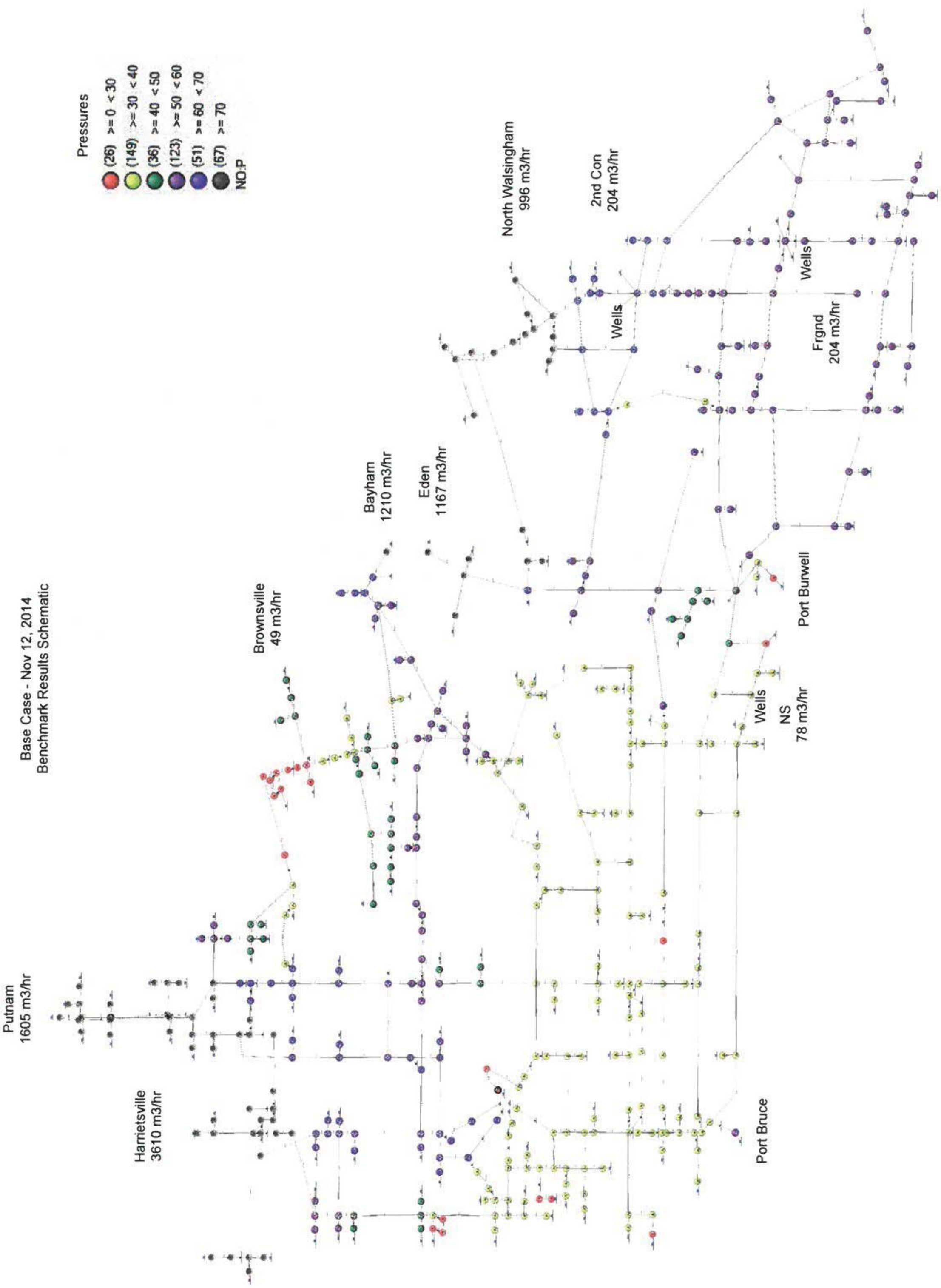

VIENNA
NATURAL RESOURCE
GAS LIMITED


AYLMER
NATURAL RESOURCE
GAS LIMITED


BELMONT
NRG
NATURAL RESOURCE
GAS LIMITED


BROWNSVILLE
NATURAL RESOURCE
GAS LIMITED
NRG
CULLODEN RD
GLOVER STREET
QUEEN ST
BROWNSVILLE ROAD
WOOD STREET
MAPLE STREET
CULLODEN LN
CANADIAN NATIONAL RAILWAY

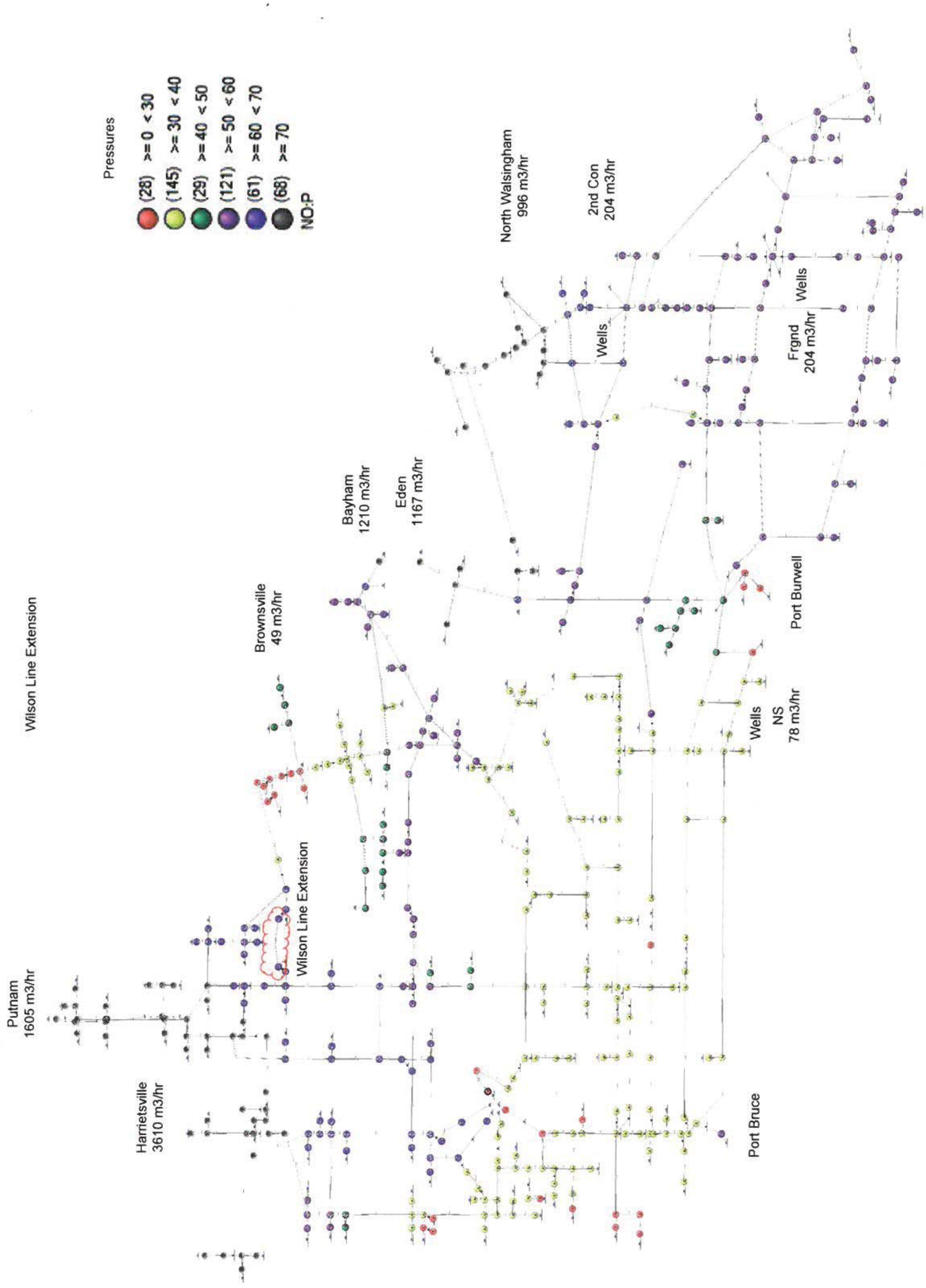
Appendix C – Benchmark Results Schematic

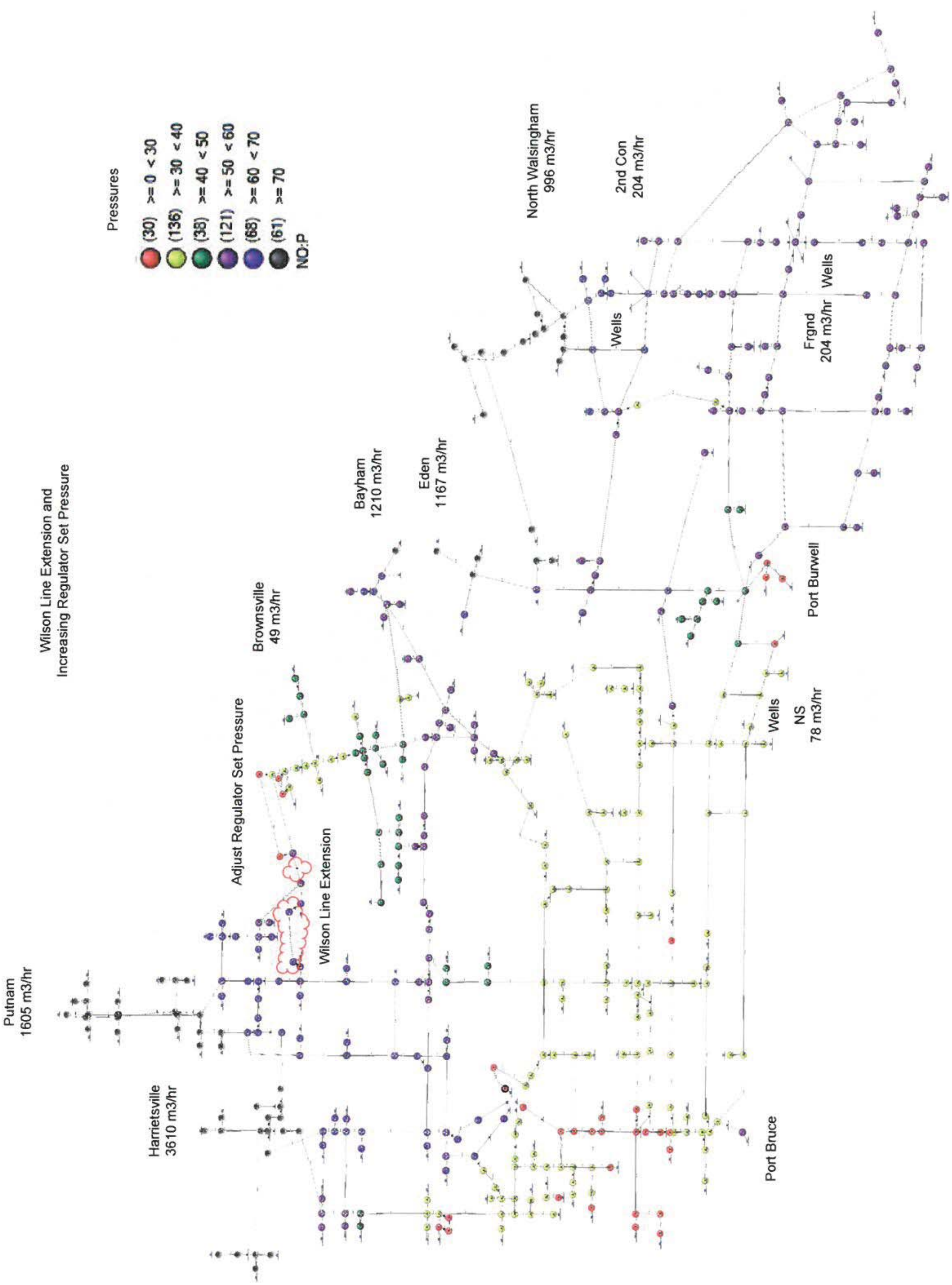

Base Case - Nov 12, 2014
Benchmark Results Schematic
Pressures
(26) >= 0 < 30
(149) >= 30 < 40
(36) >= 40 < 50
(123) >= 50 < 60
(51) >= 60 < 70
(67) >= 70
NO P
Putnam
1605 m3/hr
Harrietsville
3610 m3/hr
Brownsville
49 m3/hr
Bayham
1210 m3/hr
Eden
1167 m3/hr
North Walsingham
996 m3/hr
2nd Con
204 m3/hr
Wells
Wells
Frgnd
204 m3/hr
Port Burwell
Wells
NS
78 m3/hr
Port Bruce

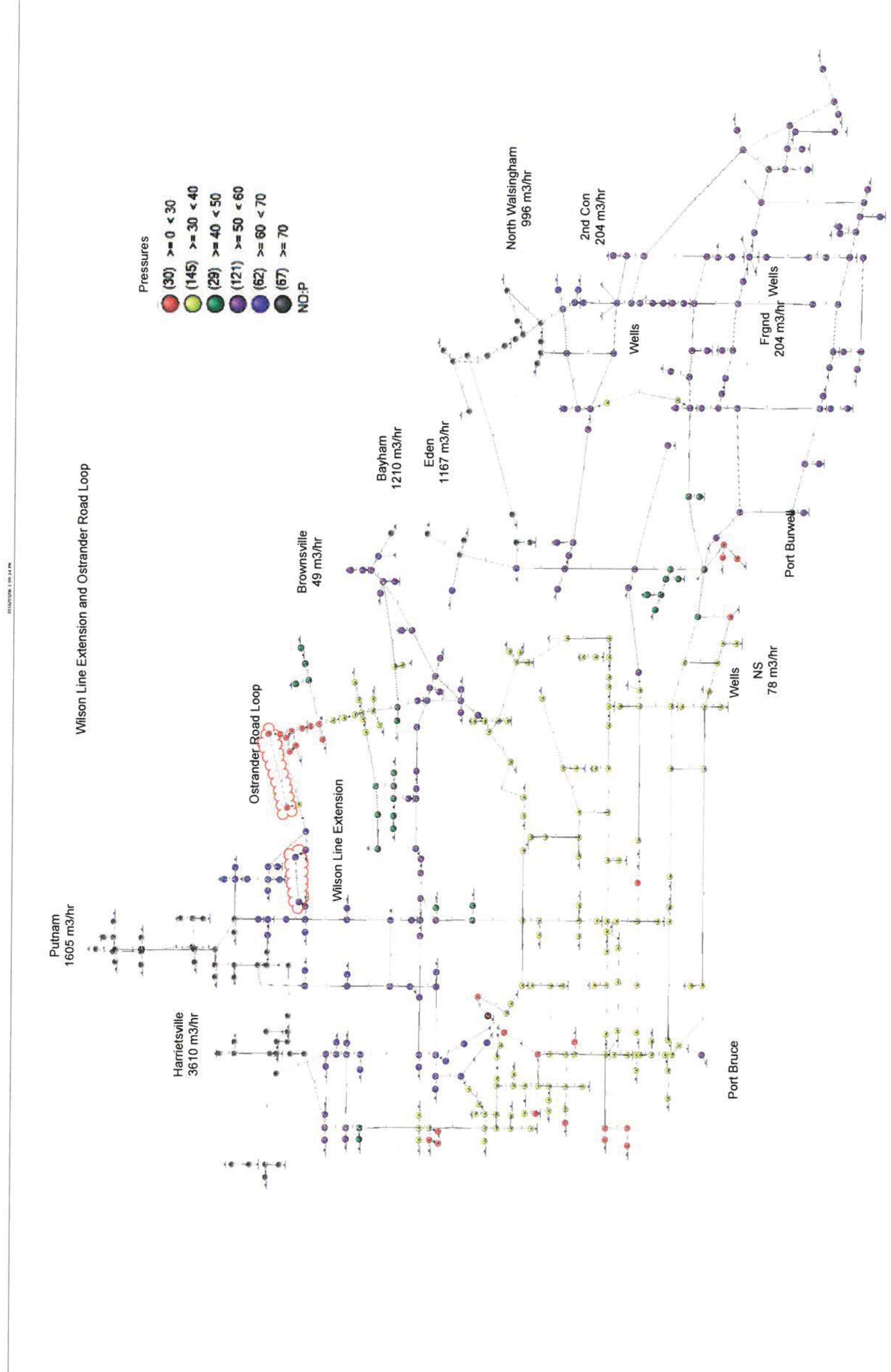
Appendix D – LOOPS AND LINE EXTENSIONS

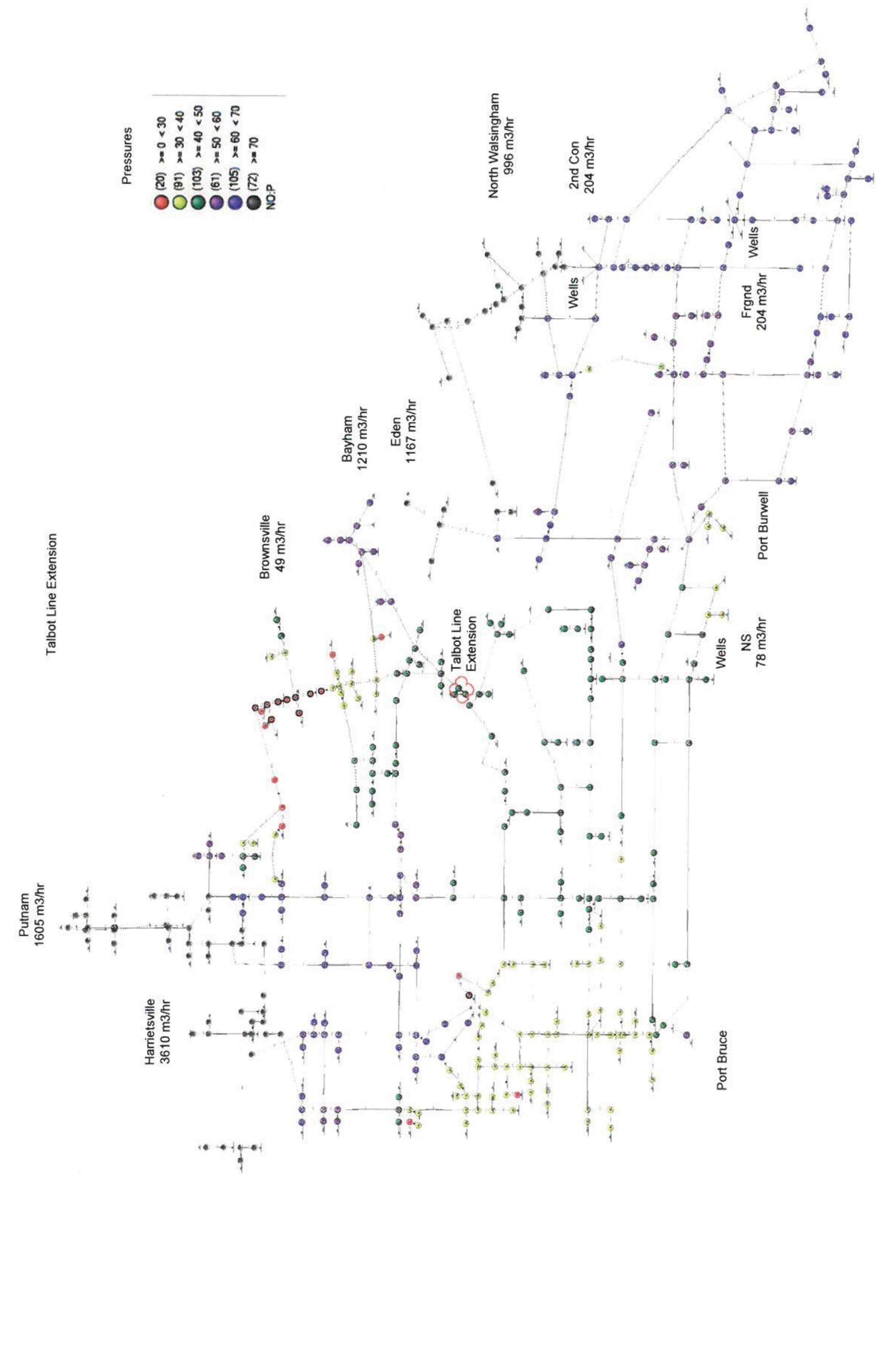

Pressures
(25) >= 0 < 30
(149) >= 30 < 40
(38) >= 40 < 50
(126) >= 50 < 60
(52) >= 60 < 70
(62) >= 70
NO:P
John Wise Line Loop
Putnam
1605 m3/hr
Harrietsville
3610 m3/hr
Brownsville
49 m3/hr
Bayham
1210 m3/hr
Eden
1167 m3/hr
North Walsingham
996 m3/hr
2nd Con
204 m3/hr
Wells
Frgnd
204 m3/hr
Wells
Port Burwell
Wells
NS
78 m3/hr
John Wise Line Loop
Port Bruce


Pressures
(17) >= 0 < 30
(33) >= 30 < 40
(140) >= 40 < 50
(127) >= 50 < 60
(70) >= 60 < 70
(65) >= 70
NO:P
Glencolin Line Extension
North Walsingham
996 m3/hr
2nd Con
204 m3/hr
Wells
Wells
Frgnd
204 m3/hr
Bayham
1210 m3/hr
Eden
1167 m3/hr
Brownsville
49 m3/hr
Port Burwell
Wells
NS
78 m3/hr
Putnam
1605 m3/hr
Harrietsville
3610 m3/hr
Port Bruce
Glencolin Line
Extension

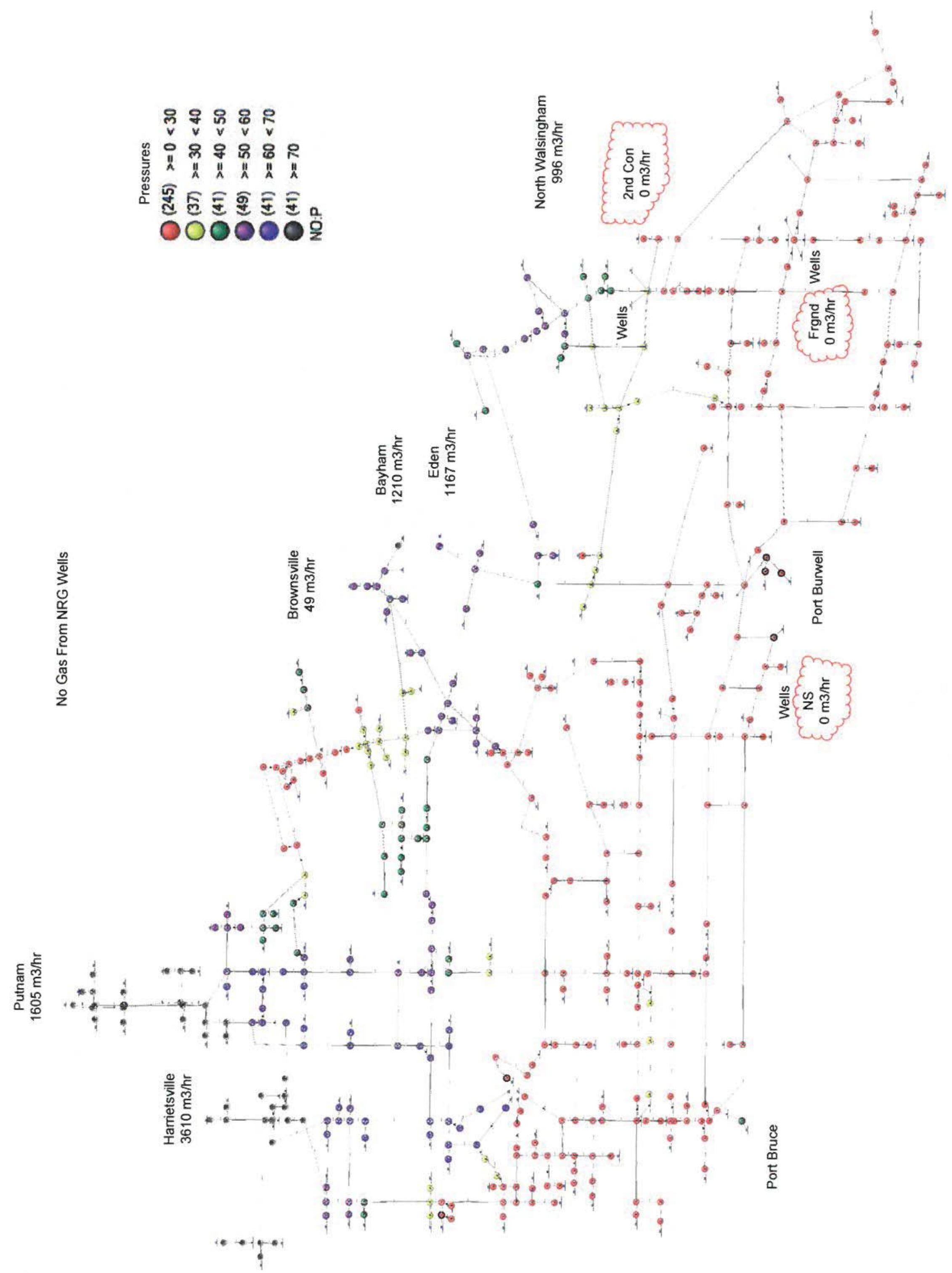

Pressures
(28) >= 0 < 30
(145) >= 30 < 40
(29) >= 40 < 50
(121) >= 50 < 60
(61) >= 60 < 70
(68) >= 70
NO:P
Wilson Line Extension
Brownsville 49 m3/hr
Bayham 1210 m3/hr
Eden 1167 m3/hr
North Walsingham 996 m3/hr
2nd Con 204 m3/hr
Wells
Wells
Frgnd 204 m3/hr
Port Burwell
Wells
NS 78 m3/hr
Putnam 1605 m3/hr
Wilson Line Extension
Harrietsville 3610 m3/hr
Port Bruce


Wilson Line Extension and
Increasing Regulator Set Pressure
Pressures
(30) >= 0 < 30
(136) >= 30 < 40
(38) >= 40 < 50
(121) >= 50 < 60
(68) >= 60 < 70
(61) >= 70
NO:P
Putnam
1605 m3/hr
Harrietsville
3610 m3/hr
Adjust Regulator Set Pressure
Wilson Line Extension
Brownsville
49 m3/hr
Bayham
1210 m3/hr
Eden
1167 m3/hr
North Walsingham
996 m3/hr
2nd Con
204 m3/hr
Wells
Frgnd
204 m3/hr
Wells
Port Burwell
Wells
NS
78 m3/hr
Port Bruce


Wilson Line Extension and Ostrander Road Loop
Pressures
(30) >= 0 < 30
(145) >= 30 < 40
(29) >= 40 < 50
(121) >= 50 < 60
(62) >= 60 < 70
(67) >= 70
ND:P
North Walsingham
996 m3/hr
2nd Con
204 m3/hr
Bayham
1210 m3/hr
Eden
1167 m3/hr
Brownsville
49 m3/hr
Wells
Frgnd
204 m3/hr
Wells
Port Burwell
Ostrander Road Loop
Wilson Line Extension
Wells
NS
78 m3/hr
Putnam
1605 m3/hr
Harrietsville
3610 m3/hr
Port Bruce


Talbot Line Extension
Pressures
(20) >= 0 < 30
(91) >= 30 < 40
(103) >= 40 < 50
(61) >= 50 < 60
(105) >= 60 < 70
(72) >= 70
NO:P
North Walsingham
996 m3/hr
2nd Con
204 m3/hr
Wells
Wells
Frgnd
204 m3/hr
Bayham
1210 m3/hr
Eden
1167 m3/hr
Brownsville
49 m3/hr
Port Burwell
Talbot Line
Extension
Wells
NS
78 m3/hr
Putnam
1605 m3/hr
Harrietsville
3610 m3/hr
Port Bruce

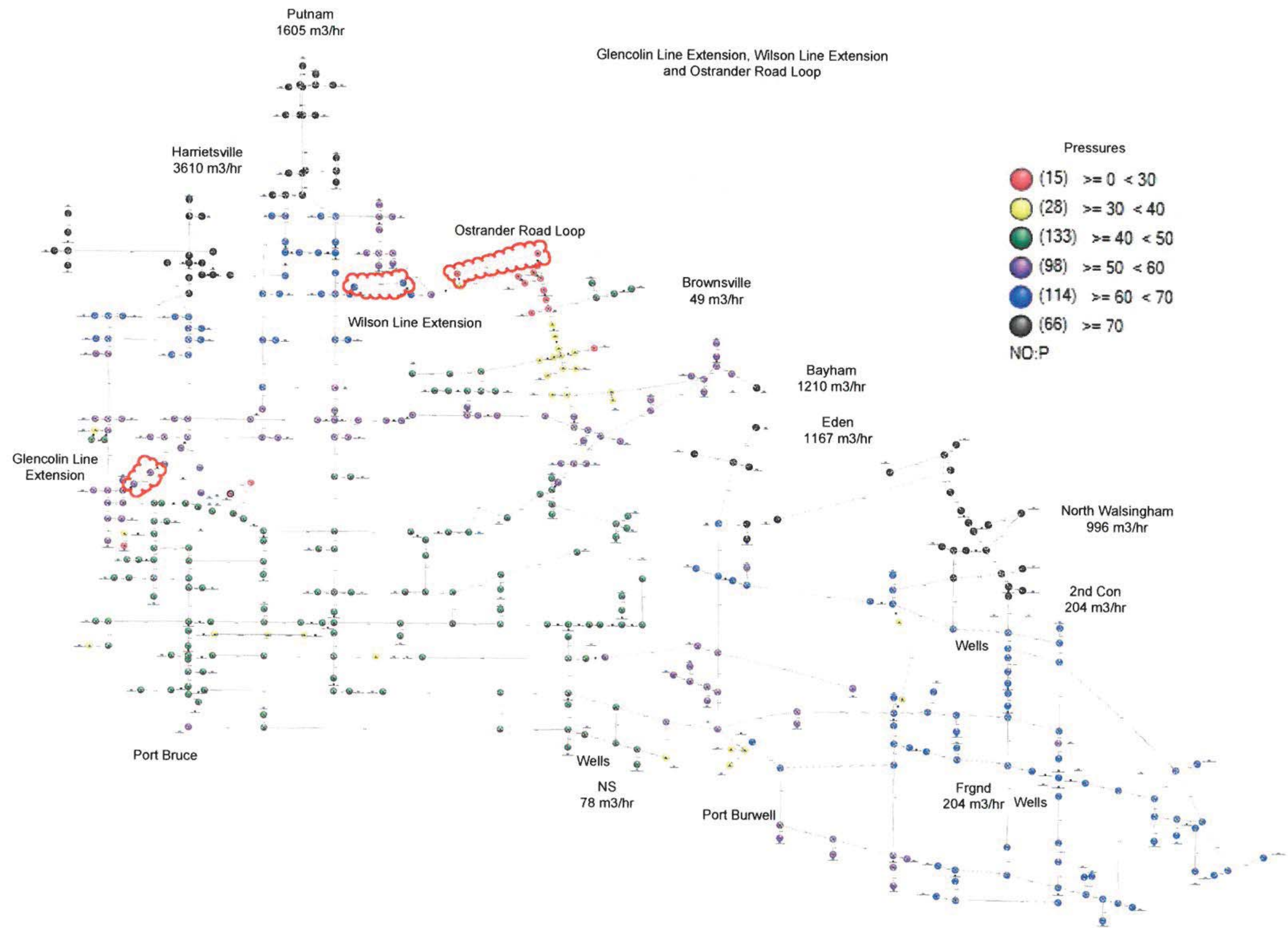
Appendix E – INCREASE UGL STATION GAS FLOW


Pressures
(245) >= 0 < 30
(37) >= 30 < 40
(41) >= 40 < 50
(49) >= 50 < 60
(41) >= 60 < 70
(41) >= 70
NO:P
North Walsingham
996 m3/hr
2nd Con
0 m3/hr
Wells
Wells
Frgnd
0 m3/hr
Bayham
1210 m3/hr
Eden
1167 m3/hr
Brownsville
49 m3/hr
Port Burwell
Wells
NS
0 m3/hr
No Gas From NRG Wells
Putnam
1605 m3/hr
Harrietsville
3610 m3/hr
Port Bruce


Increased Gas From NRG Wells
Pressures
(12) >= 0 < 30
(21) >= 30 < 40
(147) >= 40 < 50
(59) >= 50 < 60
(132) >= 60 < 70
(83) >= 70
NO:P
Putnam
1605 m3/hr
Harrietsville
3610 m3/hr
Brownsville
49 m3/hr
Bayham
1210 m3/hr
Eden
1167 m3/hr
North Walsingham
996 m3/hr
2nd Con
204 m3/hr
Wells
Frgnd
204 m3/hr
Wells
Port Burwell
Wells
NS
551 m3/hr
Port Bruce


Increased Gas From NRG Wells and John Wise Loop
Pressures
(12) >= 0 < 30
(27) >= 30 < 40
(153) >= 40 < 50
(52) >= 50 < 60
(127) >= 60 < 70
(83) >= 70
NO:P
Putnam 1605 m3/hr
Harrietsville 3610 m3/hr
Brownsville 49 m3/hr
Bayham 1210 m3/hr
Eden 1167 m3/hr
North Walsingham 996 m3/hr
2nd Con 204 m3/hr
Wells
Frgnd 204 m3/hr
Wells
Port Burwell
Wells
NS 393 m3/hr
John Wise Loop
Port Bruce

Appendix F – FINAL RESULTS


Glencolin Line Extension, Wilson Line Extension
and Ostrander Road Loop
Pressures
(15) >= 0 < 30
(28) >= 30 < 40
(133) >= 40 < 50
(98) >= 50 < 60
(114) >= 60 < 70
(66) >= 70
NO:P
Putnam
1605 m3/hr
Harrietsville
3610 m3/hr
Ostrander Road Loop
Wilson Line Extension
Brownsville
49 m3/hr
Bayham
1210 m3/hr
Eden
1167 m3/hr
Glencolin Line
Extension
North Walsingham
996 m3/hr
2nd Con
204 m3/hr
Wells
Port Bruce
Wells
NS
78 m3/hr
Port Burwell
Frgnd
204 m3/hr
Wells

Appendix G – Expansion Costs

NRG System Expansion Costs

Pipeline Segment	Pipe Size (NPS)	Pipe Price ($/m)	Length (m)	Pipe Price ($)	Drct Drills (m)	Drct Drills ($/m)	Drct Drills ($)	Trench (m)	Trenching ($/m)	Trench ($)	Marker/ Sign ($/500m)	Mob/ Demob ($)	Marker/ Sign ($)	Subtotal ($)	Cntngncy (20%)	Total ($)
Glencolin Line Extension	4	21	3,200	67,200	170	55	9,350	3,030	31.25	94,688	75	6,400	480	178,118	35,624	213,741
Wilson Line Extension	3	12	500	6,000	100	55	5,500	400	27.5	11,000	75	6,400	75	28,975	5,795	34,770
Ostrander Road Loop	3	12	4,060	48,720	215	55	11,825	3,845	27.5	105,738	75	6,400	609	173,292	34,658	207,950
Total	-	-	7,760	-	485	-	26,675	7,275	-	211,425	-	19,200	1,164	380,384	76,077	456,461

Assumptions

1) Number and length of Directional Drills/Bores
- Glencolin Line Extension 6 at 20 m each and 1 at 50 m
- Wilson Line Extension 5 at 20 m each
- Ostrander Road Loop 7 at 20 m each and 1 at 75 m

2) Cost of Directional Drill/bore for NPS 3 is the same as NPS 4

3) Cost of dry tapping and connection or fusing is included in above costs

4) Cost of clean, drying, pigging, and leak testing is included in above costs

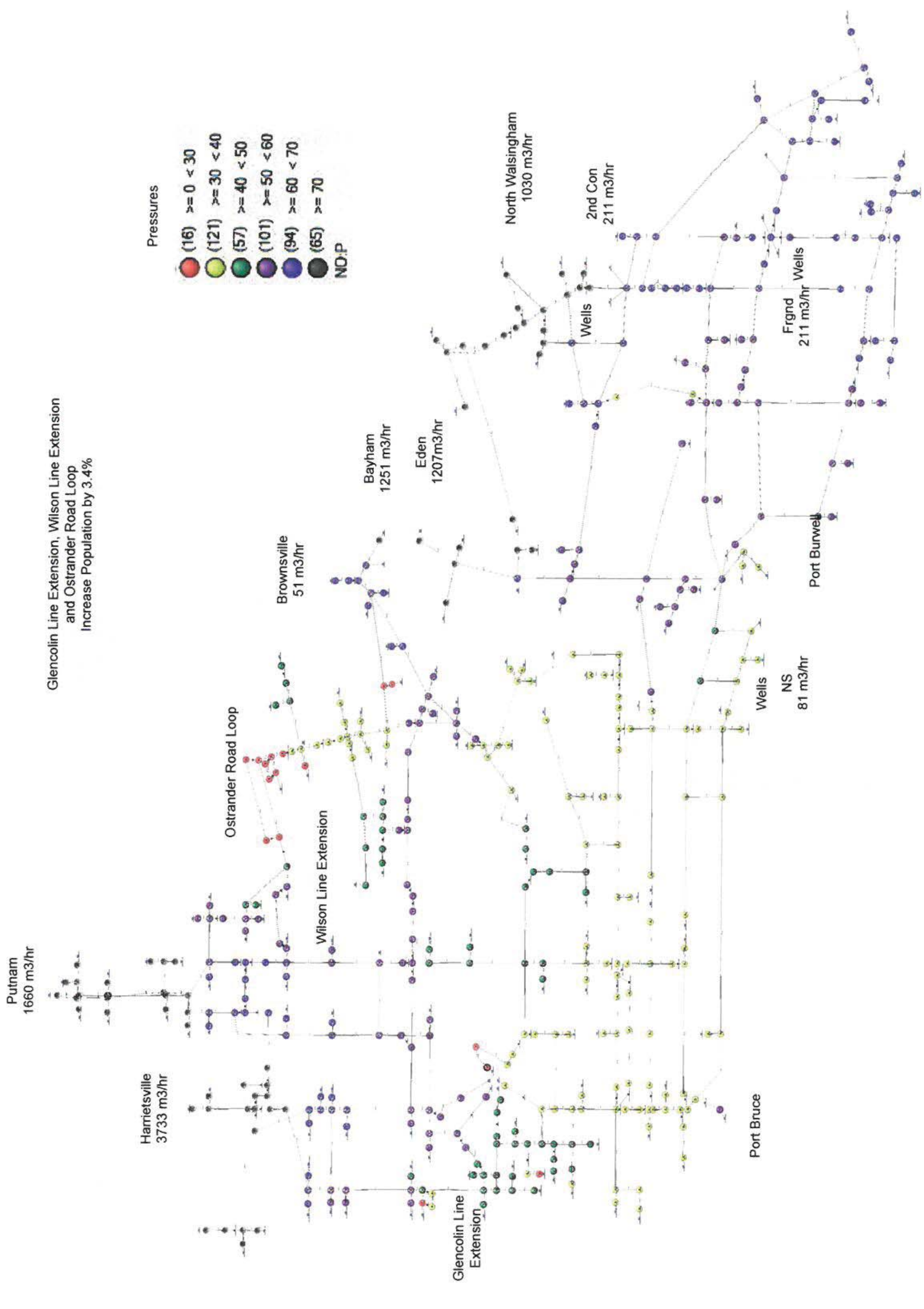
5) Installation of trace wire is included in above costs

6) Above costs are all-in including labour, management, equipment, fuel, contractors profit, etc

7) Above costs exclude
- Owner's costs
- Land costs
- Telecommunications costs
- Environmental assessment costs
- Legal and Regulatory costs
- Public/Third Party Consultation costs
- Escalation
- Construction survey costs

8) Includes Mobilization/Demobilization costs of $3200/day for 2 days

Appendix H – POPULATION INCREASE

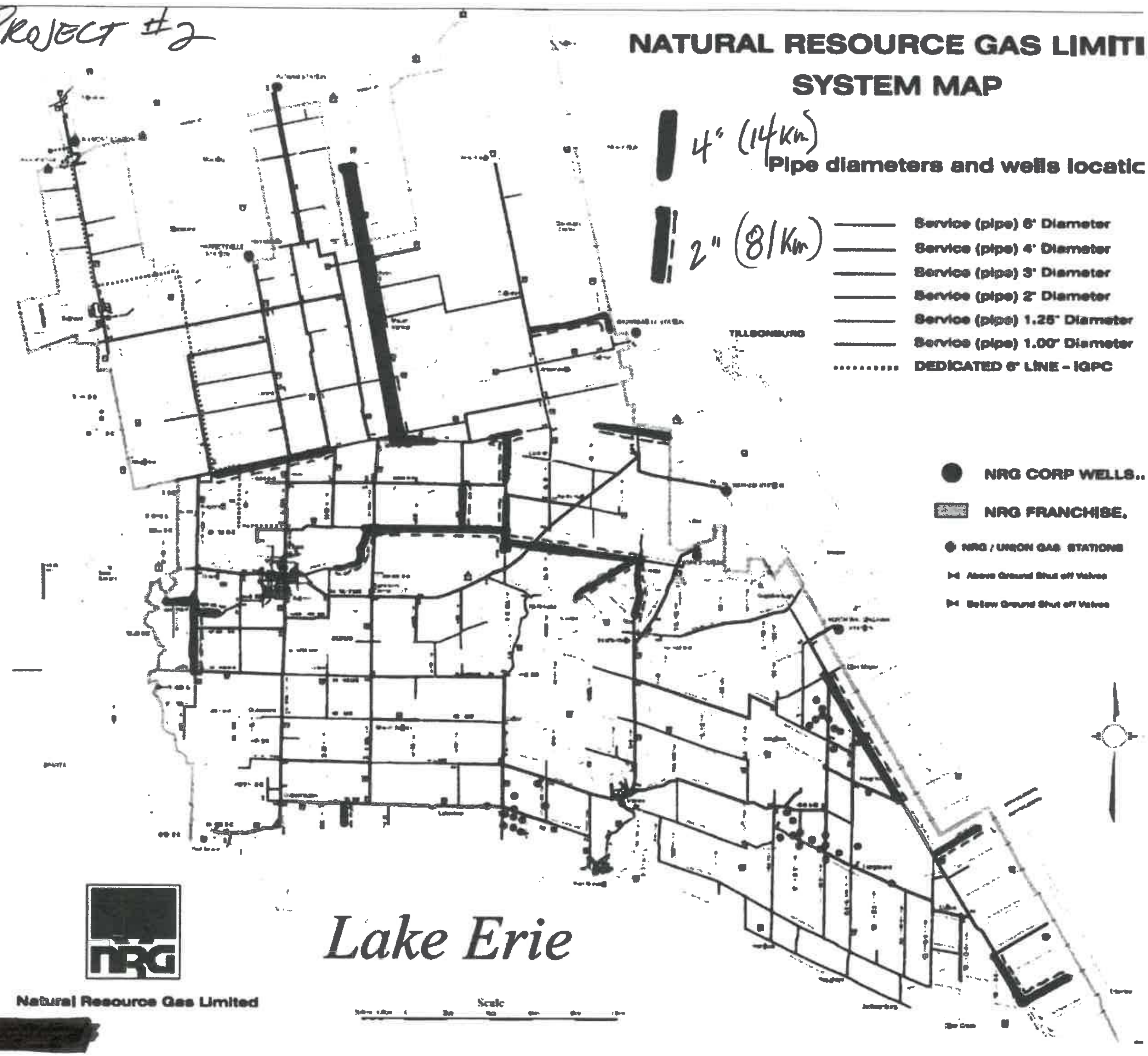

Glencolin Line Extension, Wilson Line Extension
and Ostrander Road Loop
Increase Population by 3.4%
Pressures
(16) >= 0 < 30
(121) >= 30 < 40
(57) >= 40 < 50
(101) >= 50 < 60
(94) >= 60 < 70
(65) >= 70
NO-P
North Walsingham
1030 m3/hr
2nd Con
211 m3/hr
Wells
Frgnd
211 m3/hr
Wells
Bayham
1251 m3/hr
Eden
1207m3/hr
Brownsville
51 m3/hr
Port Burwell
Wells
NS
81 m3/hr
Ostrander Road Loop
Wilson Line Extension
Putnam
1660 m3/hr
Harrietsville
3733 m3/hr
Port Bruce
Glencolin Line
Extension

THIS IS EXHIBIT "D" REFERRED TO IN THE AFFIDAVIT OF BRIAN LIPPOLD SWORN ON DECEMBER 4, 2019.

Commissioner for Taking Affidavits

DANIEL S. J. BANGARTH
Barrister, Solicitor, Notary Public
562 Waterloo Street
London, Ontario N6B 2P9
Ph (519) 472 2340 | Fax (519) 657 8173

PROJECT #2



[redacted]

Proposal for Custody Transfer Station to Supply NRG

In order to facilitate the supply of gas to NRG. NRG is willing to pay for costs to engineer and construct a new custody transfer station. In efforts to avoid: 1) an unnecessary Leave to Construct Application and; 2) Steel Piping applications that require lengthy and expensive environmental studies. NRG proposes the following:

- NRG to acquire land for intended for a new custody transfer station. Located between 1.5 and 2 km North of 401 at Pigram Line (See New Station map below). The exact distance must be determined by referencing Union's previously requested map of local infrastructure.
- NRG to contract ~~Aecon (or a~~ mutually agreed upon construction engineering firm) to engineer a hot tee from the mainline.
- NRG to drill a 6" Plastic pipe to the station location determined above from South of the 401 at Pigram Line (reduced to 4" within NRG's franchise area).
- NRG and Union to build station to accommodate a min inlet pressure of 120 psi.
- NRG to incur land acquisition, construction (station and drilling) as well as engineering costs

New Station Map

[redacted]

Brian,
Any chance of meeting this Thursday?

Patrick

Sent from my Samsung Galaxy smartphone.

-------- Original message --------
From: Brian Lippold
Date: 11-16-2015 3:48 PM (GMT-05:00)
To: "Boyer, Patrick"
Subject: RE: Practical Discussion - Union makes recommendations

I can do the 24th in Chatham. When you get a chance tomorrow, please call me and I'll run-down the Ethanol discussion with you.

Brian Lippold,
General Manager,
Natural Resource Gas Limited
Ph: 519 773-5321 Ext 205
Fax: 519 773-5335
Email: brian@nrgas.on.ca

From: Boyer, Patrick [mailto:PBoyer@uniongas.com]
Sent: Monday, November 16, 2015 3:25 PM
To: Brian Lippold
Subject: RE: Practical Discussion - Union makes recommendations

Brian,
I am heading to a meeting that will take me to the end of the day. Did you have a chance to look at your calendar for days on the 23rd, 24 or 25th that would allow you to come to Chatham? We can review the Putnam/Mossley request as well as the questions you have in your last section of the email.
Patrick

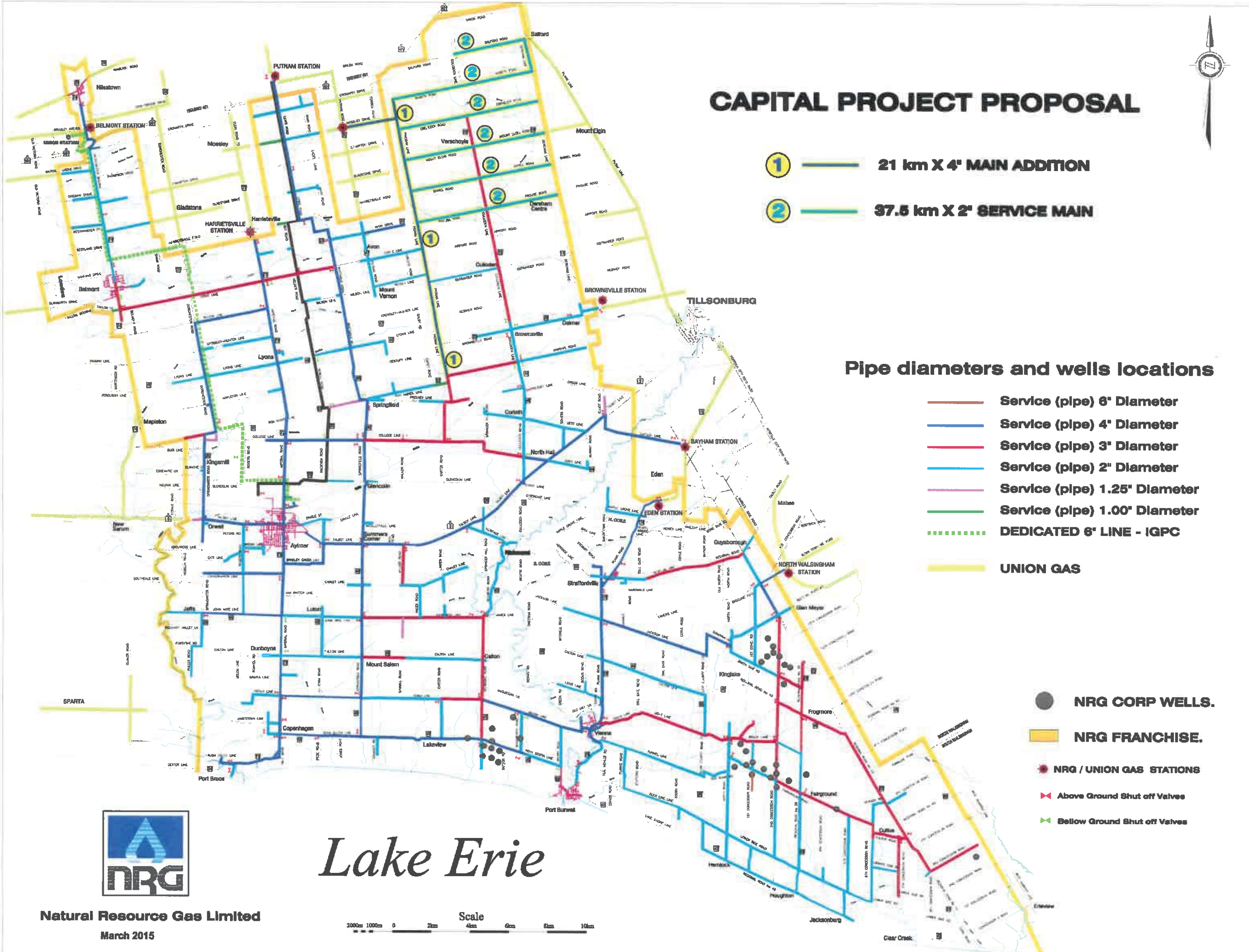
From: Brian Lippold [mailto:brian@nrgas.on.ca]
Sent: November-16-15 11:50 AM
To: Boyer, Patrick
Subject: Practical Discussion - Union makes recommendations

Hi Patrick,
I appreciated the time you took to discuss the Mossley/Putnam station this morning. I would like to get together next week with the Engineers to find out why they can't use that 125lb Putnam line to supply gas without adding a new HP line.
What I am concerned with mostly is that this is the first time that we are hearing that if Putnam/Mossley is a go, we need to run an entirely new line to that station area. So you have to go through all the hoops of getting Stantec to

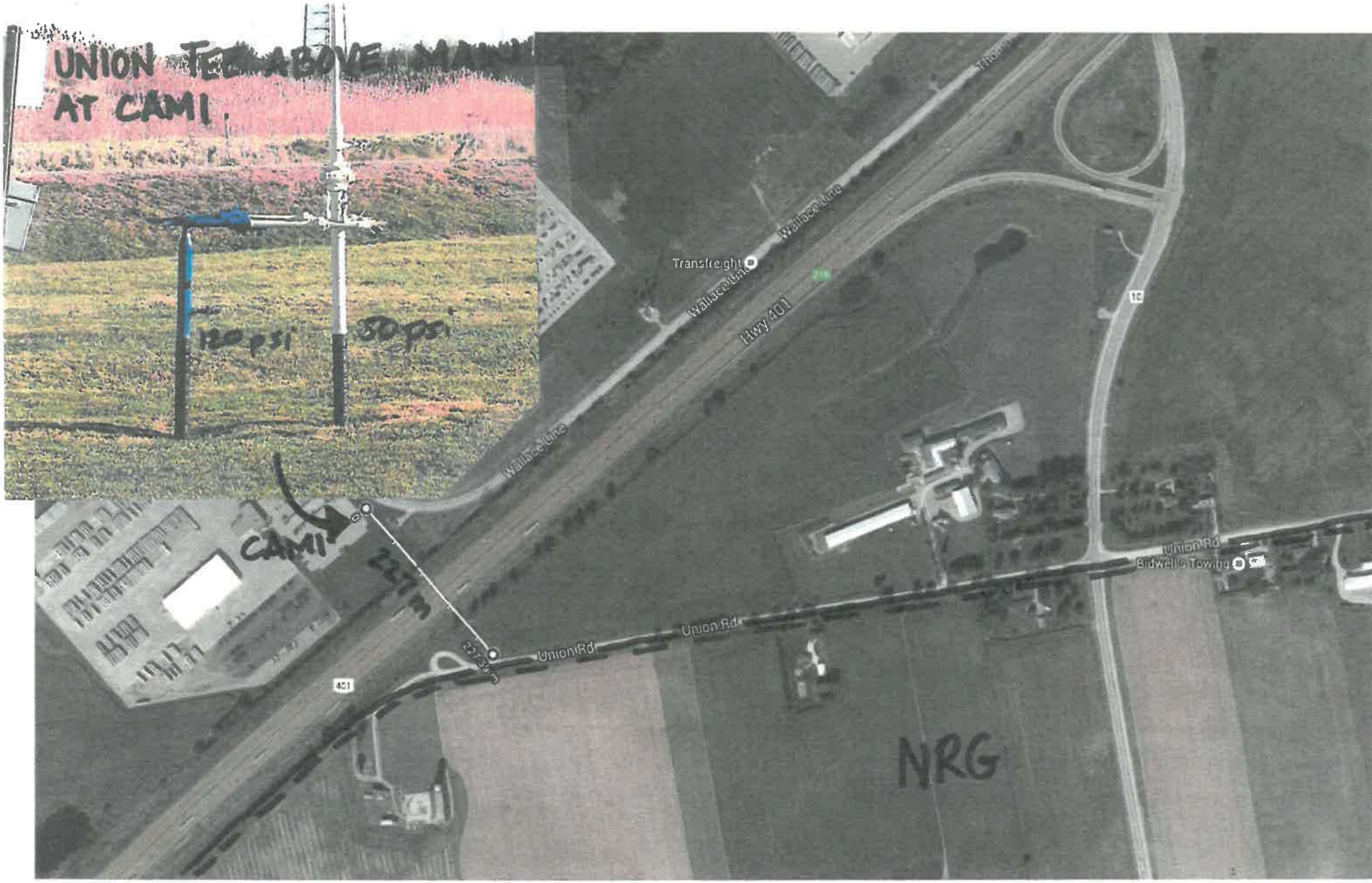
complete an environmental survey and seek approvals because you would need to run a high pressure steel line. For this most recent news, it will cost $600,000 before a shovel hits the ground. What that really means to us is your station is not valuable at that location any longer if a new HP line is required (unless of course there were no aid to construct costs to NRG).
So considering the above, why couldn't NRG take care of the construction to get the line up to an area that is close to your main line North of the 401? I can secure land there as easily as I could on the Mossley site. That avoids the environmental cost as well as the considerable expense to running steel down to that corner. It also keeps our station even closer to our border by utilizing Pigram Line further north.; something your regulatory folks were concerned with.
I know that Union is preparing a response to our filing with the board. Much of that will be legal and academic. From the field level, can we start to work toward a solution under these guidelines: what is the least expensive, most expedient way to get much needed additional gas volumes into the NE section of our franchise? To start that, could you go back to you stations group. Please ask them to provide location(s) anywhere along Unions mainline (North of our Franchise border) that allows for the simplest, most cost effective (for NRG) connection to your system. We can meet you at that point with a 4" main and manage our costs effectively; because we simply have to.
I'll call you after the discussion with IGPC.

Brian Lippold,
General Manager,
Natural Resource Gas Limited
Ph: 519 773-5321 Ext 205
Fax: 519 773-5335
Email: brian@nrgas.on.ca

From: admin@rnrgas.on.ca [mailto:admin@rnrgas.on.ca]
Sent: Monday, November 16, 2015 10:30 AM
To: Brian Lippold <brian@nrgas.on.ca>
Subject: Message from KM_C224e


CAPITAL PROJECT PROPOSAL
1 21 km X 4" MAIN ADDITION
2 37.5 km X 2" SERVICE MAIN
Pipe diameters and wells locations
Service (pipe) 6" Diameter
Service (pipe) 4" Diameter
Service (pipe) 3" Diameter
Service (pipe) 2" Diameter
Service (pipe) 1.25" Diameter
Service (pipe) 1.00" Diameter
DEDICATED 6" LINE - IGPC
UNION GAS
NRG CORP WELLS.
NRG FRANCHISE.
NRG / UNION GAS STATIONS
Above Ground Shut off Valves
Bellow Ground Shut off Valves
TILLSONBURG
PUTNAM STATION
BELMONT STATION
HARRIETSVILLE STATION
BROWNSVILLE STATION
BAYHAM STATION
EDEN STATION
NORTH WALSINGHAM STATION
Lake Erie
Scale
NRG
Natural Resource Gas Limited
March 2015


NRG FRANCHISE BORDER
UNION MAIN
NRG PUTNAM STATION
8.93 km
8.00 km
6.00 km
4.00 km
2.00 km
UNION MAINLINE
CAMI PLANT
Putnam
Banner
Rd 60
Hamilton Rd
Hwy 401
Macdonald-Cartier Fwy
PUGRAM LINE
CULLODEN LINE
NR
1900H


UNION TEE ABOVE
AT CAMI
120 psi
30 psi
CAMI
227 m
Transfreight
Wallace Line
Hwy 401
401
10
Union Rd
Bidwell's Towing
NRG

THIS IS EXHIBIT "E" REFERRED TO IN THE AFFIDAVIT OF BRIAN LIPPOLD SWORN ON DECEMBER 4, 2019.

Commissioner for Taking Affidavits

DANIEL S. J. BANGARTH
Barrister, Solicitor, Notary Public
562 Waterloo Street
London, Ontario N6B 2P9
Ph (519) 472 2340 | Fax (519) 657 8173

[redacted]

[redacted]

[redacted] [redacted]

[redacted]

From: Mark McCord <mmccord@nrgas.on.ca>
Sent: Monday, June 13, 2016 1:03 PM
To: Brian Lippold <brian@nrgas.on.ca>
Subject: Phase 2 - 4" scenarios

Brian
The numbers below look better for the HDPE pipe at 144psi. The manufacturer of the HDPE fittings that are not CSA certified says they hope to have certification by the end of the year. They also have some information they put together to help Manitoba hydro get a variance to use the fittings. The problem with just using the fittings is that they are not stamped CSA. It is the pipeline inspectors job to make sure the pipe and fittings are clearly approved (CSA B137.4). Paul checks the pipe every time we get a new shipment for approval and any pipeline inspector is going to want to see the approval on the fitting or documentation on its variance. He will know the Pipe and fittings are different because he will have to use the HDPE heating and fusion times. I think we should pursue the Variance route with TSSA, but we will have to be prepared that if they don't approve the variance, we have to use the MDPE fittings.

Let me know
Thanks
Mark

From: Huddleston, Alex [mailto:Alex.Huddleston@snclavalin.com]
Sent: Monday, June 13, 2016 12:20 PM
To: Mark McCord
Subject: RE: Phase 2 - 4" scenarios

Hi Mark,

We've extended the simulation table for the 15 km 4" pipeline and looked at inlet pressures of 144 psi.

Pressure		Flow
Inlet	Outlet	Rate
(psig)	(psig)	(m^3/hr)
144	131.1	1000
144	102.7	1800
144	20.4	2687
100	81.4	1000
100	20.9	1833

80	56.3	1000
80	22.2	1435

Thanks,

Alex

From: Mark McCord [mailto:mmccord@nrgas.on.ca]
Sent: June 6, 2016 10:10 AM
To: Huddleston, Alex
Subject: Phase 2 - 4" scenarios

Alex

Can you add 144psi inlet to this chart? I would be looking for the flowrates at roughly 80psi outlet and what kind of outlet pressure results at that same 1800m3/hr.

Thanks
Mark

From: Huddleston, Alex [mailto:Alex.Huddleston@snclavalin.com]
Sent: Tuesday, May 3, 2016 9:33 AM
To: Brian Lippold <brian@nrgas.on.ca>
Subject: FW: Phase 2 - 4" scenarios

Hi Brian,

We've completed the simulations for the 15km 4" pipeline that you' requested. The results are as follows:

Pressure Inlet	Pressure Outlet	Flow Rate
(psig)	(psig)	(m^3/hr)
100	81.4	1000
100	20.9	1833
80	56.3	1000
80	22.2	1435

In scenario 1 below with 80 psig at both the inlet and the outlet, the gas won't flow; pressure is the force that moves the gas from point to point. The flow rate of 3700 m^3/hr can't be achieved at these low pressure. At higher pressures, say about 500 psig, the flow rate can be achieved and the pressure drop is about 40 psi.

Pigging
There are 2 conditions that I forgot to mention that must be met before the 6 inch pipeline can't be inspected with an instrumented tool:

- Any valves in the pipeline must be full-bore valves, which means that the hole in the valve is 6" in diameter. I don't believe that you have any valves in the pipeline, but I'm not sure

- There can't be any short-radius bends in the pipeline. A short radius bend is a standard elbow or a bend that has a radius less than 30" (5 * the diameter)

Thanks,

Alex Huddleston
Department Manager, Pipelines
Oil & Gas

Tel.: +1 403-294-2714
Cell.: +1 403-461-1102

SNC-Lavalin Inc.
605 - 5th Avenue SW, 14th Floor
Calgary | Alberta | Canada | T2P 3H5

SNC·LAVALIN

KENTZ
Engineers & Constructors
Member of the SNC-Lavalin Group

-----Original Message-----
From: Brian Lippold [mailto:brian@nrgas.on.ca]
Sent: April 26, 2016 7:50 AM
To: Huddleston, Alex
Subject: FW: Phase 2 - 4" scenarios
Importance: High

Hi Alex,

Have you got time for a call later today?

I need some ongoing support services on a charge basis. I have some increased customer demand and I have to arrive at the appropriate contracted daily/hourly service. The following scenarios will assist me in determining the right contract volume level from Union Gas.

Scenario 1 (4" PE per attached plan)
- flow out at south end of pipeline, with an inlet of 80psi and outlet of 80 psi?
- flow out at south end of pipeline with an inlet of 100psi and outlet of 80psi?

Scenario 2 (4" PE per attached plan)
- inlet pressure of 80psi and an outlet flow of 3700m3/h, what pressure do we get at the south end of the pipeline?
- inlet pressure of 100psi and an outlet flow of 3700m3/h, what pressure do we get at the south end of the pipeline?

Scenario 3 (4" PE per attached plan)
- inlet pressure of 80psi and an outlet flow of 1000m3/h, what pressure do we get at the south end of the pipeline?
- inlet pressure of 100psi and an outlet flow of 1000m3/h, what pressure do we get at the south end of the pipeline?

Please let me know if you are able to discuss today or tomorrow.

Thanks, Brian

[redacted]

From: [redacted]
[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

From: Mark McCord <mmccord@nrgas.on.ca>
Sent: Tuesday, May 3, 2016 8:31 PM
To: Brian Lippold <brian@nrgas.on.ca>
Subject: Re: Phase 2 - 4" scenarios

Those numbers from Alex don't look very good. I agree that it would be nice to know how much volume it would take to raise the pressure of the problem areas (Bayham and Culloden), but without a true network analysis, I don't know how we would come up with those numbers.
Currently we don't meter the volumes used in the town of Belmont as a whole, I'm not sure what kind of volumes we would be looking at for that increase in customer load.
I agree with all of your questions, and think we really need answers to those questions, but I think the only way to know is a network analysis. Weather or not the one Alex did is accurate enough, I really don't know, at this point I guess it's the only thing we have. It looks like the best we are going to see off that line at 100 psi inlet and 81 out is 1000m3, so I wouldn't think our increase to Union should be much more than that.
Thanks
Mark

On May 3, 2016, at 11:00 AM, Brian Lippold <brian@nrgas.on.ca> wrote:

> As discussed, food for thought. We have to figure out what we need to raise the pressure of the weak areas of the system as well as deliver additional gas to new customers (residential and industrial) like Belmont.
>
> What might the new peak load per hour of look like in Belmont with 25 new houses (2 years) or 50 new houses in 5 years? We have to account for that in our calculations.
>
> *Brian Lippold*
>
> **General Manager,**
> **NATURAL RESOURCE GAS LIMITED**
> **PH: 519 773-5321 EXT 205**
> **FAX: 519 773-5335**

EMAIL: brian@nrgas.on.ca

[redacted]

From: Huddleston, Alex [mailto:Alex.Huddleston@snclavalin.com]
Sent: Tuesday, May 3, 2016 9:33 AM
To: Brian Lippold <brian@nrgas.on.ca>
Subject: FW: Phase 2 - 4" scenarios

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Pigging
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Thanks,

Alex Huddleston
Department Manager, Pipelines
Oil & Gas

Tel.: +1 403-294-2714
Cell.: +1 403-461-1102

SNC-Lavalin Inc.
605 - 5th Avenue SW, 14th Floor
Calgary | Alberta | Canada | T2P 3H5

<image001.jpg>

<image002.jpg>

-----Original Message-----
From: Brian Lippold [mailto:brian@nrgas.on.ca]
Sent: April 26, 2016 7:50 AM
To: Huddleston, Alex
Subject: FW: Phase 2 - 4" scenarios
Importance: High

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Have you got time for a call later today?

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- inlet pressure of 100psi and an outlet flow of 1000m3/h, what pressure do we get at the south end of the pipeline?

Please let me know if you are able to discuss today or tomorrow.

Thanks, Brian

THIS IS EXHIBIT "F" REFERRED TO IN THE AFFIDAVIT OF BRIAN LIPPOLD SWORN ON DECEMBER 4, 2019.

Commissioner for Taking Affidavits

DANIEL S. J. BANGARTH
Barrister, Solicitor, Notary Public
562 Waterloo Street
London, Ontario N6B 2P9
Ph (519) 472 2340 | Fax (519) 657 8173

ENGLP AYLMER SYSTEM INTEGRITY STUDY

Rev: 0 Date 12/19/2018

1 CONTENTS

2 EXECUTIVE SUMMARY

EPCOR Natural Gas Limited Partnership (ENGLP) engaged Cornerstone Energy Services (Cornerstone) in May 2018 to complete a system integrity analysis of its Aylmer natural gas distribution utility. Cornerstone created a steady-state hydraulic model of the system and reviewed the predicted system conditions under the current peak gas demand, seen in January 2018, and predicted future peak demands, given predicted growth through 2024. The objectives of the study were to identify constraints within the system that would impact the utility's ability to provide reliable natural gas service to current and future customers, and identify and evaluate possible system reinforcement options to resolve these issues.

The analysis identified two areas of concern: low pressure supply to the northern district regulating stations serving the Belmont and pressure starvation in the southern and southeastern part of the system. This confirms operating data and observations provided by operating staff.

The analysis identified and confirmed that the issue with Belmont can be addressed by increasing undersized pipeline sections along Westchester Bourne that are choking the flow of gas being delivered to the village.

Three projects were identified and confirmed as options to address the low pressure issues in the south and southeastern part of the system: on-system trailered compressed natural gas (CNG) storage at one of two general locations or tying to a new natural gas supply from a third-party producer near Lakeview. Providing additional volumes to the area will boost the pressure which drops significantly during peak demand and provide the capability to serve new customers that the utility has had to decline to service in the past.

Preliminary capital cost estimates were developed for the options identified.

3 BACKGROUND

ENGLP Natural Gas Limited Partnership (ENGLP) owns and operates the Aylmer natural gas utility, a local distribution company (LDC) that distributes natural gas in Southern Ontario to approximately nine thousand customers in the Town of Aylmer and the surrounding region.

The service territory extends south from Highway 401 to the shores of Lake Erie. In addition to the Town of Aylmer, the ENGLP system also serves the towns of Brownsville, Straffordville, Vienna, Port Burwell, Port Bruce, Springfield, Belmont, and Nilestown.

The ENGLP Aylmer system consists of approximately 800 kilometers of distribution mains which are fed by seven ENGLP/Union Gas gate stations (Putnam, Harrietsville, Belmont, Brownsville, Bayham, Eden, and North Walsingham) and 38 natural gas wells, owned by a 3rd party, in the southeastern part of the system.

ENGLP has contracted Cornerstone to perform a system integrity study and to evaluate and develop capital cost estimates (CAPEX) for several capital improvement projects that will enhance performance and capacity of the system to meet the needs of existing customers and future growth.

4 STUDY OBJECTIVES

The system integrity analysis included three tasks. Those tasks and the results are outlined in the sections below.

1.) Model and Calibrate the Distribution System

The first task included developing a hydraulic model of the existing gas distribution system, and calibrating that model to operational pressure and flow records made available by ENGLP operations personnel. This task is discussed in Section 5.

2.) System Constraints Identification, Growth Modeling, and Infrastructure Improvements

The main purpose of this study was to identify keys areas of the system that are weak points in the integrity of the system to support existing customer demands and areas that are hindering the growth and expansion of the system for future planning. After identifying these areas, Cornerstone was tasked with developing a list of projects to address these areas and evaluate the effectiveness each project had at addressing the needs of the system using the GASWorkS model. It is in this section that the existing natural gas well supply is evaluated as a means to maintain system integrity. This task is discussed in Section 6.

3.) Capital Cost Estimate (CAPEX) Development

Upon the evaluation of the effectiveness of each infrastructure improvement project identified in the second task, a project was either escalated to the next phase of developing a capital cost estimate or removed from consideration.

5 SYSTEM MODELING AND CALIBRATION

Cornerstone used the distribution system modeling program GASWorks version 10.0 to develop a steady-state model and analyze system performance.

5.1.1 Gas, Model, and Piping Assumptions

Hydraulic efficiency: 0.95

Elevation: 235 ft

Gas average temperature: 15 °C

Specific Gravity: 0.583

Gas Viscosity: 7.2×10^{-6} lbm/ft-sec

Heating value: 1027 btu/cf

Specific heat ratio: 1.31

Flow Equation: IGT Improved

5.1.2 Model Development

The model development consisted of 2 major steps. These steps are discussed below.

1.) Creating system infrastructure

    ENGLP provided CAD files and a database of attributes for each piping segment in the system, albeit with some information lacking on some of the piping segments. GIS analysts used this information to develop a shapefile which was then imported into GASWorkS. The GASWorkS model was then checked against the CAD records, a system map provided by ENGLP, and field technicians and operations personnel familiar with the system to ensure the information regarding pipe sizes, segment connections at intersections, and valve station locations was accurately depicted in the GASWorkS model. This process determined that there is some conflicting information across system documentation and some misinformation in CAD records. In these cases, the information offered by operations personnel was taken as accurate in finalizing the GASWorkS piping model.

    The number of inconsistencies between the various records led to the conclusion that ENGLP would benefit from a Model and Facilities Verification Project, which is further described in Section 6.5.

2.) Applying Load Points

    In addition to the distribution piping, town load points and customer load points needed to be placed in the model.

    Town load points are load points at which a town’s gas load is taken from the distribution system. This allows for simplification the modeling of the performance of the system. Instead of drawing in individual gas lines and services in a town that the ENGLP system feeds, we can apply a load point representative of the gas that entire town is estimated to be using for a certain scenario. In the case of a town like Straffordville which operates at “high pressure” and all the distribution piping sees as much as 80 psig from the two-inch line on Heritage Line, a single point was placed on that line and assigned a load value to draw off of that node point as shown in Figure 1.

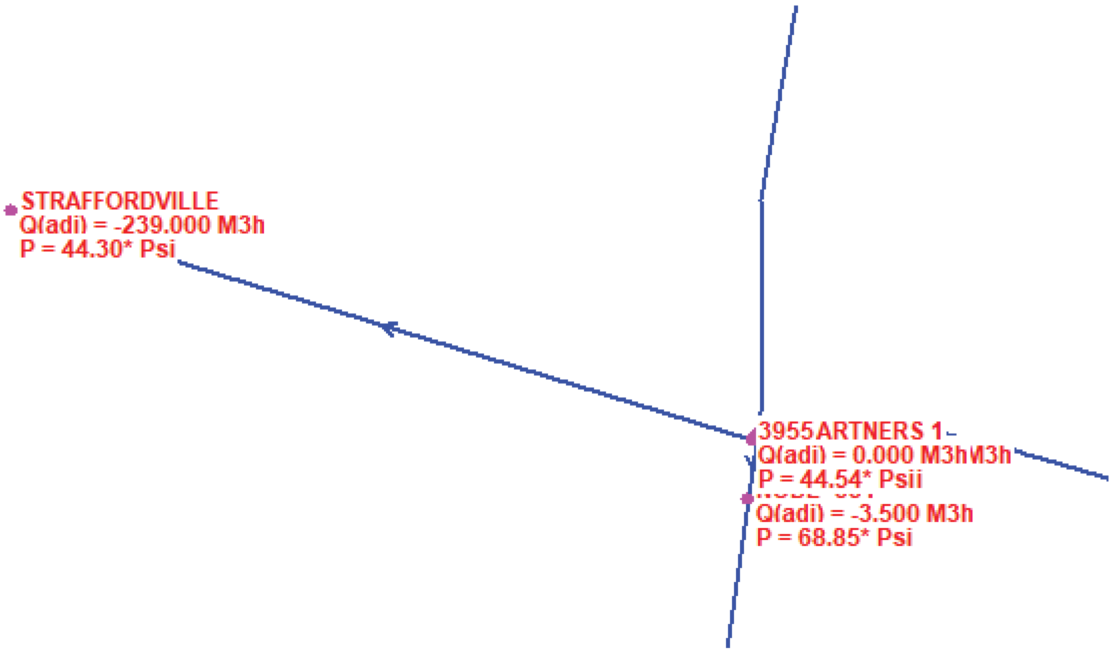


Figure 1: Town Load Point

In the case of a more complex town like Aylmer which operates at as a 30 psig system, there are district regulator stations that feed the town, so regulators had to be inserted into the model at the applicable locations, and the loads taken from the downstream side of those valves. See Figures 2 and 3 below that indicate how this was done in GASWorkS.

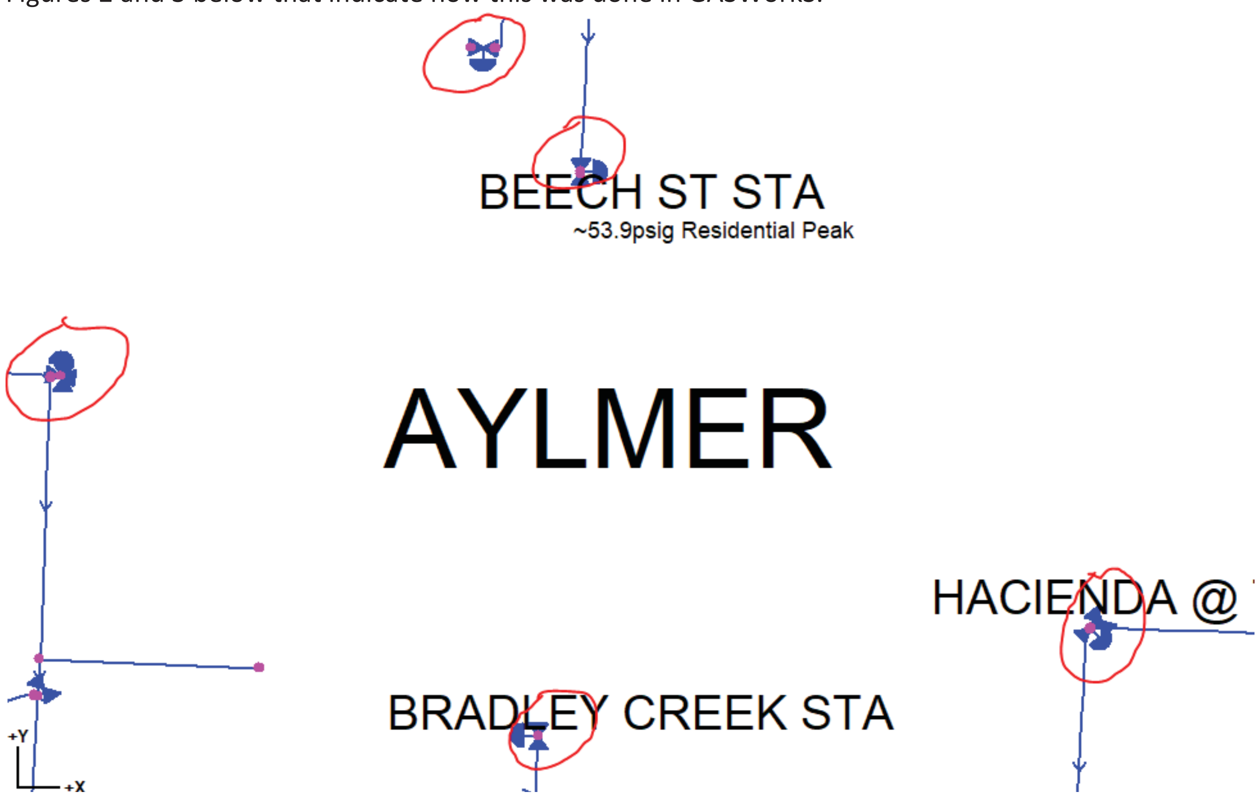


Figure 2: Aylmer regulator stations

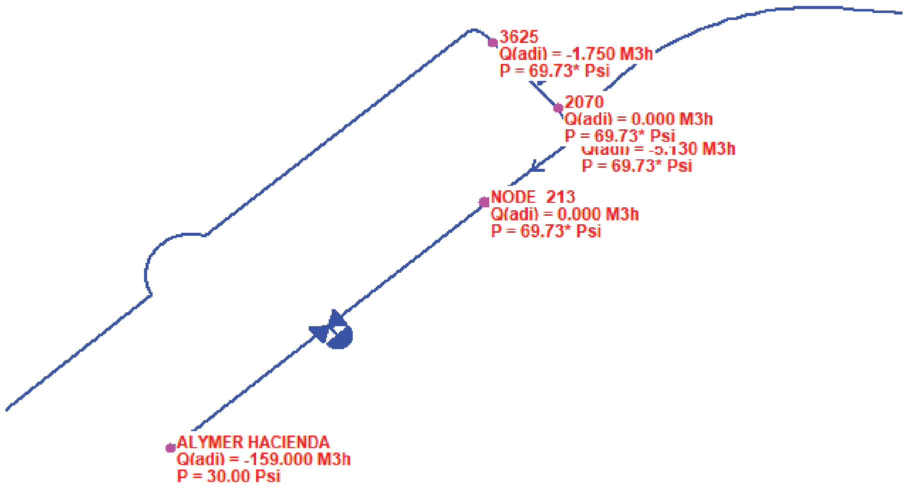


Figure 3: Hacienda station regulator orientation

The towns of Aylmer, Belmont, and Brownsville, and Port Burwell operate as 30 psig systems so all four towns were modeled accordingly.

The loads that the nine major towns draw from the gas system make up the majority of the gas consumed but there are distributed loads to be accounted for. The CAD files provided by ENGLP were used to locate these distributed customers. They were then broken down into two types of customer load points – smaller residential customers and larger, seasonal (interruptible) customers. The figure below shows two different colors of customer points.

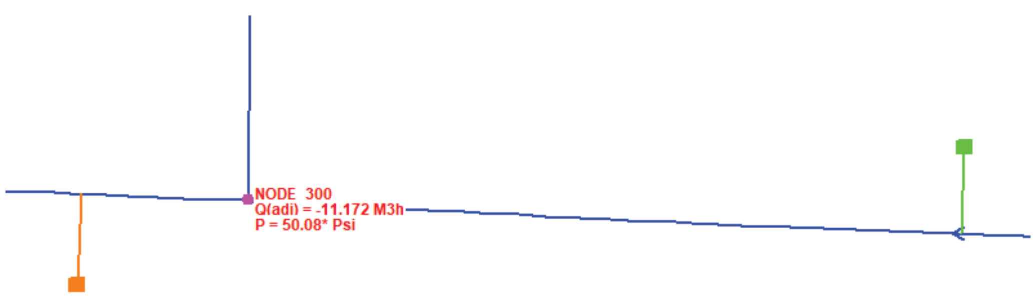


Figure 4: Customer Load Points

An orange square indicates a seasonal customer with a larger load whose energy rates are based on the ability to interrupt their gas service if the system is being overstrained. A typical customer of this type would be a grain dryer who may not need the ability to dry their crops in the middle of January. All of these such customers were identified by ENGLP operations personnel and were input as a different color in the model so as to be able to easily turn their gas loads on and off when modeling the gas consumption of the system at different times of the year. Green squares indicate uninterruptible customers (typically residential or year-round commercial customers). Instead of having hundreds of these points throughout the model, service lines between two node points were counted (minus the identified larger, interruptible customers) and a single green customer load point was placed halfway between the two nodes with a unit count equal to that number of service lines. For example, if nine houses were shown to have service lines to them along Conservation Line between Springwater Rd and Imperial Rd, one green customer load point was placed in the model with a unit count of “9”.

5.1.3 Loading Determination

The biggest difficulty in establishing an accurate model for this system was the loading throughout the system. Cornerstone was provided some historic metering data for the ENGLP Aylmer system for the winter of 2017-2018 that the model was calibrated to, as discussed in a later section. However, gas is not metered using district meter stations for each of the towns the system serves, which necessitates that a peak hour consumption estimate be developed for each town center. With the town loads making up a large majority of the consumption, based on the number of customers located in the towns compared to the distributed customers, this introduced a rather large unknown. The method to establishing town loads was a three-step process as outlined below.

1.) Establish a “calibration hour” for the model

This data point was selected as the peak hour within the date of the highest gas consumption for the 2017-2018 heating season. The gas readings from the ENGLP/Union Gas stations would be used to determine hourly readings for each station for calibration purposes, but the date was also needed in order to estimate how much gas each typical customer would be consuming during that day using historical weather data as outlined below.

2.) Establish distributed customer loads

The larger “seasonal” (interruptible) loads had historic billing information provided, so the unknown remaining for this step was how much each of the distributed customers was using. From previous projects in similar climates in Canada, research had been done on determining peak day gas consumption for residential customers.

Residential peak consumption was estimated using an approximation method outlined in a 1994 study titled *Gas Peak Day Design Analysis*[1] and inputting historical weather data values for the Aylmer region on January 4th and 5th of 2018. This period of data was selected because it was determined as the peak consumption period for flows into the ENGLP Aylmer system according to data provided. The exception to the method outlined in the study was that the “disposable income” factor was neglected in calculating the peak day values. The method outlined in the study used Equation 1, below, to calculate a firm send out peak in standard cubic feet for a year, which is then translated to cubic feet per day and cubic meters per day and cubic meters per hour.

Equation 1:

*Sendout (ft^3/yr) = (-2840.87*Current Day Wind-Chill) + (-127.59*Previous Day Wind-Chill) + (-8.5946*Current Day Wind-Chill^2)*

Where "Wind-Chill" is a value based on weather records for the design peak day in that

"Wind-Chill" = (.0817(3.71*SQRT(WIND)) + (SQRT(WIND)) + (5.81) – (.25*WIND))*(TEMP – 91.4) + 91.4*

Where "WIND" is in units of mph and "TEMP" is in units of °F.

Weather data for these equations was gathered from the Canadian government weather station[2] for the London Ontario station. Inputs for the referenced equations are outlined in Table 1.

Table 1: Weather Data for Calibration

CURRENT DAY Jan 5th WIND CHILL		
WIND	8.3	MPH
TEMP	-18.6	deg. F
WINDCHILL	-38.2231527	deg. F

PREVIOUS DAY Jan 4th WIND CHILL		
WIND	7.4	MPH
TEMP	-17	deg. F
WINDCHILL	-33.0510248	deg. F

Thus

Daily Send out = (-2840.87*(-38.223)) + (-127.59*(-33.05)) + (-8.5946*(-38.223)) = 161,716.91 ft^3/yr

= 443.06 ft^3/day

= 12.6 m^3/day

=0.53 m3/h

Estimating that each house during this calibration date of January 5, 2018, was consuming roughly 0.5m^3/h of gas, the total distributed loads could then be estimated.

3.) Subtract total distributed gas load from the total consumption, leaving the remainder as the gas consumed by the towns

4.) Estimate the customer count in each town

Having a customer count in each town allows the remaining gas consumption (after distributed loads are accounted for) to be assigned to each town, proportionate to the number of customers a town has compared to the others. Customer counts from a 2014 report prepared by SNC Lavalin[3] indicated the following house counts for each town:

- Aylmer - 2030
- Belmont - 555
- Brownsville - 150
- Nilestown – 100
- Port Burwell – 319
- Port Bruce – 150
- Springfield – 235
- Straffordville – 150
- Vienna – 150

Per ENGLP personnel, growth is typically between 2.5% to 3% throughout the region with the exception of Belmont, which sees 5% growth. Below is a table outlining the growth factor used to estimate a new customer count for the year 2018.

Table 2: Customer Counts

Town	2014 Count	Growth Factor	2018 Count	% of Total Town Customers
Aylmer	2030	2.5%	2241	51.86
Belmont	555	5%	675	15.62
Brownsville	150	2%	162	3.75
Nilestown	100	3%	113	2.62
Port Burwell	319	3%	359	8.31
Port Bruce	150	3%	169	3.91
Springfield	235	3%	264	6.11
Straffordville	150	3%	169	3.91
Vienna	150	3%	169	3.91

Regardless of a scenario being modeled, after the distributed loads were accounted for, gas loads were applied to each town using the proportions listed above.

5.1.4 Model Calibration

As mentioned previously, ENGLP provided Cornerstone some historical flow data for the 2017-2018 heating season. One of the primary goals of the system integrity study was to create and fine tune a

GASWorkS model to reflect pressures seen at the custody transfer stations and at points throughout the system that reflect what is seen in real data points (if available) or looks realistic in terms of what operations personnel see in the field for those points in the system that don't have recorded data (i.e. a regulating station inlet like Bradley Creek Station.)

The general process for calibrating the model is the gate stations flow points are set to known (gas in), and then the model is run and solved, accounting for where gas is consumed at the towns and by the distributed customers (gas out). The resulting pressures at gauged points in the system are then analyzed and compared to what the real data says it should be. This is an acceptable way to analyze the model as we know that flow into the system must equal flow out (gas being consumed). If meter readings are available, and overall consumption breakdown between distributed loads and town loads is known, there should be no error within the flows the model is seeing, other than changes in line pack through the system, which are reasonably ignored in this analysis.

The known points in the system, and the known parameter(s), are listed below.

Table 3: Known Data Points

Point	Parameter
Putnam Station	Pressure, Flow
Harrietsville Station	Pressure, Flow
Bayham Station	Pressure, Flow
Eden Station	Pressure, Flow
North Walsingham Station	Pressure, Flow
Nilestown Station	Pressure, Flow
Bradley Ave Station	Pressure, Flow
Beech St Station (Aylmer)	Pressure
FS Partners	Pressure
2nd Concession Wells	Pressure
Nova Scotia Line Wells	Pressure
Fairground Regional 28 Wells	Pressure
Dorchester Station (Regulator station)	Pressure

In previous analyses of this system's integrity, the month of November had days that were considered the peak scenario of gas consumption. In November, seasonal agricultural loads are still active and drawing gas from the system. These loads, coupled with decreasing temperatures and the resulting increasing heating loads, caused a record consumption on November 12, 2014. The seasonal agricultural loads, however, are largely interruptible. ENGLP chose to focus on the January 2018 peak load, when seasonable customers were not using gas and thus interrupting these customers is not an option to control the peak. The November 2014 peak demand was approximately 10% higher than the January 2018 peak modeled. System constraints identified under the January peak would only be worse under the November peak, and any solutions identified would serve to resolve pressure issues under both scenarios

January 5th had the highest gas consumption on record since the November 2014 event according to the historical data provided by the ENGLP Aylmer operations personnel. Since the gas being consumed during this time was by uninterruptible customers, the goal was to construct the base case model to reflect the gas meter readings that each Union station was seeing, as well as the pressure recordings at the stations and at the several other points in the system. The model is set up with flows in m^3/h, so a peak hour was chosen for January 5th based on the hour with the largest meter readings. This was 9:00am. The total meter readings for the 8:00-9:00am hour were 9747 m^3/h, thus all loads had to equal that number. Using the estimated residential customer usage found in Section 3.1.2, the distributed loads were estimated at 3649 m^3/h and thus the town loads had to account for 6,098 m^3/h. Using the proportions based on customer count estimations in Table 3, each town was assigned the following loads:

Table 4: Town Flows for Calibration

Town	Load (m^3/h)
Aylmer	3171
Belmont	955
Brownsville	229
Nilestown	159
Port Burwell	508
Port Bruce	239
Springfield	373
Straffordville	239
Vienna	239

It is important to note that for the initial run of the model, for the towns with multiple feeds such as Aylmer or Port Bruce, the load was evenly distributed amongst the feeds. During the calibration of the model, the town feeds were adjusted as a way of helping fine tune the model to get data points to match.

5.1.5 Calibration Results

The initial run of the GASWorkS model showed poor results when compared to historical records and anecdotal testimonies of real-world pressures throughout the system. Some stations were showing pressures well above 90 psig on the outlet side, not possible given that gas cannot physically enter the system greater than 80 psig, and certain areas of the system known to be strained for gas pressure during peak heating were showing more than adequate pressure. The goal was to show less than a 10% error in pressure readings and/or flow readings for our known points compared to the model results. As a result, the following changes were made to the GASWorkS model in order to achieve that 10% error.

1.) For Aylmer Regulator stations, 80% (~2540 m^3/h) of flow directed through Beech St Station and 5% (159 m^3/h) flow directed through the other four stations.
2.) Harrietsville, Eden, Nilestown, and Bradley were all set to know *pressures* even though all the others were set to known *flows.* The flows were then the parameter that was judged against the actual meter readings.
3.) Well flows were set to zero for the calibration of the model to the peak hour. Well head pressure or supply flows for the production from each of the well groups was not provided, reviewed or input into the model. Gas production in the past has been declining from these wells and the last study performed by SNC Lavalin[3] estimated production from all 3 wells groups

(2nd Concession Rd, Fairground Rd, and Nova Scotia Line) to be less than 500m^3/h. Talks with ENGLP Aylmer operations personnel indicated that figure to be much smaller in recent times, closer to 200 m^3/h. During peak heating demand, 200 m^3/h is approximately 2% of total system demand. As explained later, the model had difficulty converging on accurate results in the area these wells are located, even without the well inputs. Having the wells supply of 200 m^3/h turned on in the model created even larger error in the area so it was decided these wells would be turned off for hydraulic modeling.

4.) The 4-inch line along York Line was connected to the 6-inch Line running south along imperial road, just south of the York/Imperial intersection. See figure 5 below.

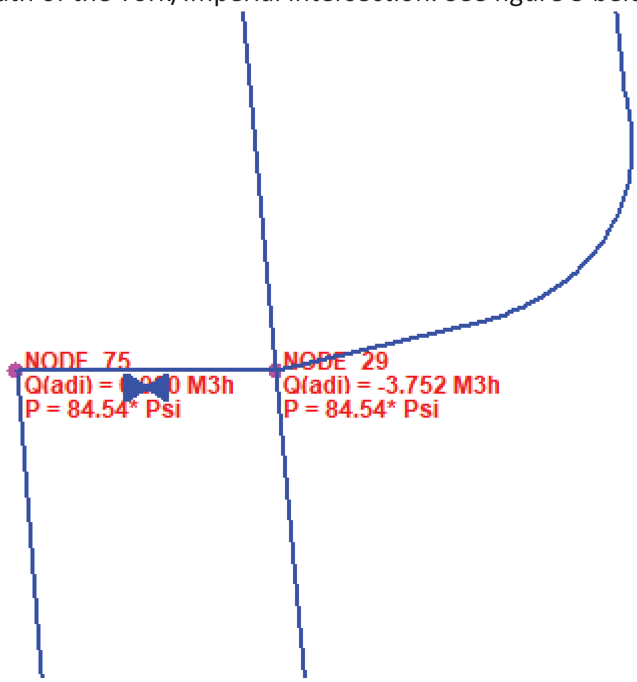


Figure 5: 4-inch York Line and 6-inch Imperial Road lines connected via NODE_29

5.) Section of 4-inchin pipe along Vienna Line between Richmond Rd and Woodworth Rd was turned OFF (no flow allowed through it) See line shown in red in Figure 6.

6.) Section of 4-inch pipe along Nova Scotia Line between Richmond Rd and Woodworth Rd was turned OFF (no flow allowed through it). See line shown in red in Figure 6.

Below is a table outlining the results of the calibrated model versus real data points.

Table 5: Calibrated Model Results vs Real Data

Data Point	Model Pressure (psi)	Base Load (m^3/h)	[1]Total Load (m^3/h)	Calibration Type	Calibration Value (Real Data)
North Walsingham Station	66.76	963.000	963.000	Pressure	80.00
Nova Scotia Line Wells	54.82	0.000	0.000	Pressure	44.00
Eden Station	82.60	1192.283	1188.3	Flow	1076.00
Dorchester Station	134.2	0.000	0.000	Pressure	122.00
FS Partners	68.86	0.000	0.000	Pressure	75.000
2nd Concession Wells	58.16	0.000	0.000	Pressure	63.00
Harrietsville Station	87.00	2710.358	2709.858	Flow	2855.000
Nilestown Station	145.00	616.272	616.272	Flow	645.000
Beech Station	57.19	0.000	-2.000	Pressure	54.00
Putnam Station	89.19	2294.000	2293.000	Pressure	85.00
Bayham Station	85.21	946.000	944.750	Pressure	82.00
Fairground Wells	56.25	0.000	0.000	Pressure	55.00
Bradley Station	147.00	979.000	979.000	Flow	976.000

1.) Total load accounts for errors in the model after the model is run and “solved”

A color-coded graphic of the solved calibrated model can be found in Appendix A. For the most part, calibration results are acceptable within 10% of the desired value. The biggest discrepancy in this model is in the southern part of the gas system, as evident by looking at the pressure results shown at the Nova Scotia Line Wells. ENGLP personnel’s testimony and real-life pressure readings indicate that the southern and south eastern part of the system are typically between 40 and 45 psig during peak scenarios. Modeling results show that although this area of the system is indeed the part of the system experiencing the lowest pressures during peak loading scenarios, pressures should not be so low that they are being starved of volumes. The model predicts pressures throughout the south and southeast to be in the 55 psig range.

6 SYSTEM CONSTRAINTS IDENTIFICATION, GROWTH MODELING, AND INFRASTRUCTURE IMPROVEMENTS

6.1 SYSTEM CONSTRAINTS IDENTIFICATION

Upon analyzing the modeling results, Cornerstone has identified two main areas of concern for the distribution system integrity:

1.) Southern and southeastern area of the system (Nova Scotia Line, 2nd Concession Rd, Fairground area.)
2.) Westchester Rd pipeline, acting as one of two feeds to the town of Belmont.

Regarding Issue 1, there is a discrepancy between modeling and real-life data in the southern and southeastern territory of the Aylmer system which is briefly discussed in the calibration results above. This discrepancy prompted discussions between Cornerstone and ENGLP regarding the conditions of these pipes in the southern and southeastern end of the system and the accuracy of the piping records ENGLP has on file. In these discussions it was brought up that operations personnel have been slowly addressing choke points discovered in the system over time. These choke points have ranged from incorrectly sized valves (smaller than full line size valves) to undersized branch connections (for example a 1” saddle on a 3” line branching to a 2” line.) Cornerstone believes that these undersized fittings and valves littered throughout the system contribute to the error between the southern pressures in the calibrated model and what the system has been seeing according to recorded data and operations personnel. As such, an operations effort project was suggested to address these choke points. This effort is discussed in Section 6.5. Regardless of whatever discrepancies exist between modeling numbers and real-world pressures, it is universally agreed upon that this area of the system is in need of reinforcement. Operations personnel closely monitor this area during times of high demand, adjusting the system’s various supply points and district regulator stations and isolation valves to ensure that this area receives as much gas as possible. Increased operations cost and the risk of current customers having their gas supply interrupted during the heating season make this an area of high concern.

The second area for concern being shown by the modeling is that the northern feed for the town of Belmont (the gas feed from Belmont station) is seeing pressures below 40 psig at the inlet of the regulator station. Given that this town operates at 30 psig, the small differential pressure is concerning for reliable and smooth operation of the town’s low-pressure distribution system. As discussed later in the report, the town of Belmont is experiencing a large amount of growth compared to other regions in the utility’s territory, so not only is this a current issue, but will only get more concerning when considering new customer connections.

Note that the model was calibrated to match gas consumptions associated with January 5, 2018, data. As outlined in section 5.1.3, residential heating consumption was estimated using weather data from that date. Although cold (-19°F/-28°C), January 5th was not a record cold day for the area. The Aylmer area has seen temperatures colder than -30°C in the winter in recent years according to weather records[1]. If there are back-to-back days of temperatures sub -30°C, the system could very well experience record gas consumption, taxing the integrity even more so than this past year.

6.2 Future Growth Modeling

Once a calibrated model was created, Cornerstone was tasked with evaluating the system's capabilities for growth and expansion through the year 2024. Recall that Table 4 outlined flows that were used for each of the major towns when calibrating the model to what Cornerstone believes is an accurate depiction of flow volume distribution throughout the system. To account for growth, some assumptions had to be made regarding customer growth rates through 2024. The following estimates were discussed with ENGLP and ultimately used in the GASWorkS model.

Table 6: Growth Rates For Future Expansion

Town	2018 Gas Load (m^3/h)	Growth Rate (yearly) %	2024 Gas Load (m^3/h)	Added Volumes (m^3/h)
Aylmer	3171	2	3572	401
[1]Belmont	955	2.5%	1108	153
Brownsville	229	2%	258	29
Nilestown	159	2%	180	21
Port Burwell	508	2%	572	64
Port Bruce	239	2%	269	30
Springfield	373	2%	421	48
Straffordville	239	2%	269	30
Vienna	239	2%	269	30
Distributed Customers	3649	1%	3873	224
			TOTAL ADDED VOLUME	1030

1.) Belmont customer growth regarding the number of added connections has been closer to 5% but is mostly new construction with added efficiencies so gas volumes were modeled as only a 2.5% increase each year.

Cornerstone estimates that by 2024, on a similar peak day to that experienced on January 5, 2018, the gas system could be demanding an additional 1030 m^3/h to meet customer demands. To model this growth, these new volumes needed to be supplied from one or several of the Union gate stations that feed the ENGLP Aylmer system. ENGLP has expressed that Bayham Station, Eden Station, and North Walsingham are already on the verge of being taxed to their limit in terms of what they can supply during a peak demand period. As such, these new volumes were to be supplied on the Northern part of the system. Based on their knowledge of the Union Gas system, ENGLP suggested that 100% of these new volumes be modeled as coming from Bradley Station, so modeling was performed under the assumption that all of the new volumes demanded by the system were to come from Bradley Station in the Northwestern part of the system. Appendix B shows the results of this growth scenario modeling.

As expected, pressures in the southeastern part of the system showed a decrease compared to the 2018 model. Pressures throughout the area have dropped an average of 5 psi. Attention is drawn to this area because as it is an area of concern right now for being thin for volumes during peak situations. Adding more customers throughout the system will only exacerbate the issue. As a result, this area of the system is a primary focus for reinforcement through infrastructure improvement projects.

It is interesting to note that if these extra volumes for growth can be taken from Bradley station, some pressure issues associated with the Belmont North regulator station can be alleviated, by throttling the feed to Belmont from the south as opposed to the North. However, the issue remains that the southern end of the system needs to be addressed so, ultimately, a two-pronged approach is being considered for these two concern areas.

6.3 Infrastructure Improvement

Current peak scenarios and the gas demand associated with future growth have prompted ENGLP to undertake this integrity analysis. This study has identified that there are two areas for concern that should be addressed right now, ensuring integrity of the system to meet current needs and allow for additional customer connections in the future. The infrastructure improvement projects discussed below aim to address low pressure concerns in the southern and southeastern part of the gas system, and the issue concerning the town of Belmont and the low pressures that are seen at the regulator station on the northern part of town.

Seven different capital improvement projects were discussed amongst the Cornerstone team and the ENGLP Aylmer team. Those projects are described below.

Please see Appendix C for a visual regarding the location of the projects outlined in the following sections.

Project 1: Make the town of Brownsville high pressure.

The idea behind this project would be to eliminate the three regulator stations that feed the town of Brownsville, eliminating a "dead end" for any gas that reaches Brownsville. This was anticipated to take some demand off of Bayham station that is used to feed Aylmer, by using Brownsville station to feed the Hacienda and Bradley Creek Stations of Aylmer. Brownsville is a smaller station however, and ultimately this project showed negligible benefit to the system.

Project 2: CNG decanting stations – North of Vienna OR located near the intersection of Springfield Rd & Vienna Line

The flexibility of being able to place a CNG source anywhere on the system is very attractive to ENGLP. The idea behind this project would be a spot North of Vienna along the 4 inch line that travels through the town, or somewhere on the 4inch line along Vienna Line near Springfield Road. The site would fit on a small piece of land where CNG trailers could be delivered and hooked up to a let-down skid, introducing 80 psig gas into the system during the winter months when the system is in need of additional volumes and pressure reinforcement. At minimum, ENGLP would have the capital cost associated with the land, civil/site work, minor mechanical and electrical/communications work, and a turn-key, pre-engineered CNG decanting station. The natural gas would be contracted during the heating season. The CNG trailers would be trucked in and swapped out at a rate of approximately 2 trailers per day during peak demand and would provide reinforcement to the southern part of the system when it needs gas the most.

For modeling purposes, 750 m^3/h was used as supply flow when modeling each of these two CNG locations. It proved to be greatly beneficial to the system surrounding where the feed was applied, showing increases of 7 to 10 psi near low pressure areas. 750 m^3/h corresponds to about the volume supplied by two CNG trucks per 24-hour period. Although the 4 inch pipeline can handle more than this volume and the southern and southeastern territory could use more volume, operating at more than that would involve additional traffic and be more logistically demanding. Modeling results for this scenario can be seen in several visuals provided in Appendix D.

Project 3: Replace all 2 inch piping running North-South along Westchester Road that feeds the Northern regulator station of Belmont.

This project was developed solely to address low pressure concerns that modeling has shown at the Northern regulator station of Belmont. Belmont station is the primary feed to Belmont currently, and the amount of gas flowing is too much for that pipeline in its current state. There is a 1.4 km section of 2 inch pipe between Cromarty Drive and Thompson Drive and another 1.7 km section between Dingman Drive to the regulator station, according to existing piping records. By upsizing those two sections of pipe to 4 inch runs to match the rest of that mainline along Westchester, pressure greatly improves along that section of pipe. The modeling results are shown in several visuals found in Appendix D, along with the Lakeview project ENGLP is considering. These are modeling results showing results for the estimated 2024 gas demand.

Project 4: Connect the 2 inch pipe on Gladstone Drive to the dedicated 144 psig line running along Dorchester Road. Drop Bradley Avenue station to 80 psig feed to accommodate.

This project was developed to address the pressure concerns regarding Belmont. By connecting those two pipes, Belmont station would not be the only source of gas for the Northern feed of Belmont. When modeled, this did show drastic improvements in pressures getting to Belmont. However, a secondary effect of this project was that pressure along Nova Scotia Line and the rest of the southern part of the system saw a decrease in pressure. This was an adverse effect and may address one problem the Aymler system is experiencing but would make the problems in the south worse.

Project 5: Add another 80 psig meter station near North Walsingham from a 3rd party (not Union). Connect station to 4 inch outlet piping of North Walsingham Station.

The idea behind this project was to add another source of gas to the 3 main eastern feeds in hopes of reinforcing the south eastern part of the system. Adding this source proved beneficial to the south eastern part of the system, as expected. Other options provide a greater benefit to the system, however, and ENGLP advises that coming to agreeable contractual terms may be more difficult than other options reviewed. .

Project 6: Indigenous gas supply from existing Lakeview station on Gully Road

ENGLP has been exploring the possibility of taking gas from an existing compressor station on Gully Road off of Nova Scotia Line (between Granger Road and Carter Road) and injecting the gas into the 4 inch pipe along Nova Scotia Line. The compressor station is centrally located along a main backbone to the southern end of the ENGLP Aylmer system which, as mentioned before, is a low-pressure concern during peak conditions. It is also relatively close to the town of Vienna and has several paths to feed that town and the south eastern part of the system near Fairground and Cultus. This project does not have the flexibility that a CNG station offers in terms of only contracting gas when it is needed, but this station offers several benefits that the CNG station does not.

1.) It will be less expensive to install a small metering and regulating station for this supply point. The gas should also be less expensive when compared to the compression and trucking costs associated with the CNG option.
2.) There is no trucking involved, which avoids the logistical/security of supply issues and negative public perception, but it also means ENGLP is not as limited to the amount of gas they can take. CNG trailers are only so big and logistics become more difficult if ENGLP decides to start pushing more than two trucks a day of CNG into the system from a single decanting station.

With this project, the Lakeview feed would be tying into the existing 4 inch line along Nova Scotia, so it is ideal to run at least a 4 inch line up to the interconnect, instead of limiting the supply with a smaller pipe. Using a 4 inch pipe from the Lakeview station to a connection to Nova Scotia line, the Lakeview station could easily supply 1700m^3/h to Nova Scotia line while maintaining reasonable gas velocities in the pipe and an injection pressure of 70 psig. See Appendix F for the calculations.

Recall that the 2024 gas demand is estimated at 1030 m^3/h above current peak demand of this gas system. By adding the new station and a new 4 inch line to feed Nova Scotia line, much needed volumes are added to the system and they are being added in an area of need, providing volumetric and pressure reinforcement to a system that is being taxed during peak hours. Appendix D shows the modeling results of adding this new gas source. These are modeling results showing the estimated 2024 gas demand, applying all 1030 m^3/h of additional gas supply from this Lakeview station instead of the Bradley station as was done in Appendix B.

Project 7: Relocate Port Burwell Regulator stations closer to town.

Port Burwell operates as a 30psig system. There are two 2 inch lines that feed the town. Both regulator stations are located in excess of 1 km away from the town center. This run of relatively small pipe causes a substantial pressure drop and gas reaching the town is approximatley20 psig or less, . a 10 psi drop. If growth is substantial in Port Burwell over the next few years and demand spikes, the pressure Port Burwell sees will drop even lower.

6.4 Capital Cost Estimates

Upon evaluation of the benefits each potential project has on the system, shown through modeling, certain projects were escalated to the capital cost estimate phase. If a project showed little benefit, an estimate was not developed. A total of three capital cost estimates were developed.

1.) CNG Decanting station (Project 2)
2.) Westchester Road pipeline upgrade (Project 3)
3.) Lakeview station gas source (Project 6)

These capital cost estimates and all assumptions made in the development of the estimates can be found in Appendix E.

6.5 Model and Facilities Verification

In the model creation, calibration, and analysis involved in this project, Cornerstone and ENGLP have determined that there may be some inaccurate information regarding piping facilities in the ground when compared to the documentation on file for the system. The measures that have been taken to calibrate the GASWorkS model lead Cornerstone to believe that what is shown in CAD records and in other sources of piping records do not match what is in the ground in certain areas. As such, Cornerstone advises that the ENGLP increase their efforts in investigating and resolving some of the choke points briefly discussed in Section 6.1. Cornerstone suggests developing a project effort aimed to execute the following tasks:

1.) Identify key problem areas according to the GASWorkS model results.
2.) Excavate (Cornerstone suggest vacuum excavation) locations identified in step 1.
3.) Document existing conditions, fittings etc.
4.) If piping or valves are undersized or incorrectly fittings exist, remove and replace accordingly.
5.) Document as-left conditions.
6.) Recalibrate the GASWorkS model to reflect the true piping of the distribution system.

Having accurate records of piping facilities will cut down on operations costs and make system improvements and capital planning easier for years to come.

7 Conclusion & Recommendations

The ENGLP gas distribution system serving Aylmer and the surrounding communities along the shore of Lake Erie is in need of capital investment to reliably meet the current demand of the customers it serves and to support system project growth. In recent winters, the southern and southeastern part of the system has been stressed for pressure, without experiencing the full potential of a large cold snap. The system requires both volumetric and pressure reinforcement from a new source of gas in that area to make up for the gap that increased peak day demand and declining well production rates have created. A new gas source provides much needed volumes for the area and will allow other meter stations the capability to serve the needs of growing customer bases in the surrounding communities, and will allow the flexibility to sign new larger volume customers that have historically been denied service in recent years given the fragile state of the system as it sits now. Both on-system storage (CNG) and a new gas supply from the Lakeview compressor station are viable options for addressing this issue. In the town of Belmont, a simple pipe size upgrade can address low pressure concerns for gas being delivered to the northern part of town, ensuring that Belmont consistently sees 30psig gas as is currently designed.

Modeling efforts have revealed that gaps exist in the physical records of installed facilities throughout the system particularly in the south and southeast regions of the system. Steps should be taken to systematically identify the areas where improvement in material records and mapping are required and to correct those areas.

8 REFERENCES

1. Broehl, Kerry Elaine, *Gas Peak Design Day Analysis*, Dayton, OH: Wright State University, 1994

2. Historical Climate Data published by Government of Canada, http://climate.weather.gc.ca/

3. Morr, John, "Transient Simulations of the NRG Distribution Systems Report", SNC Lavalin, Mar. 2016.

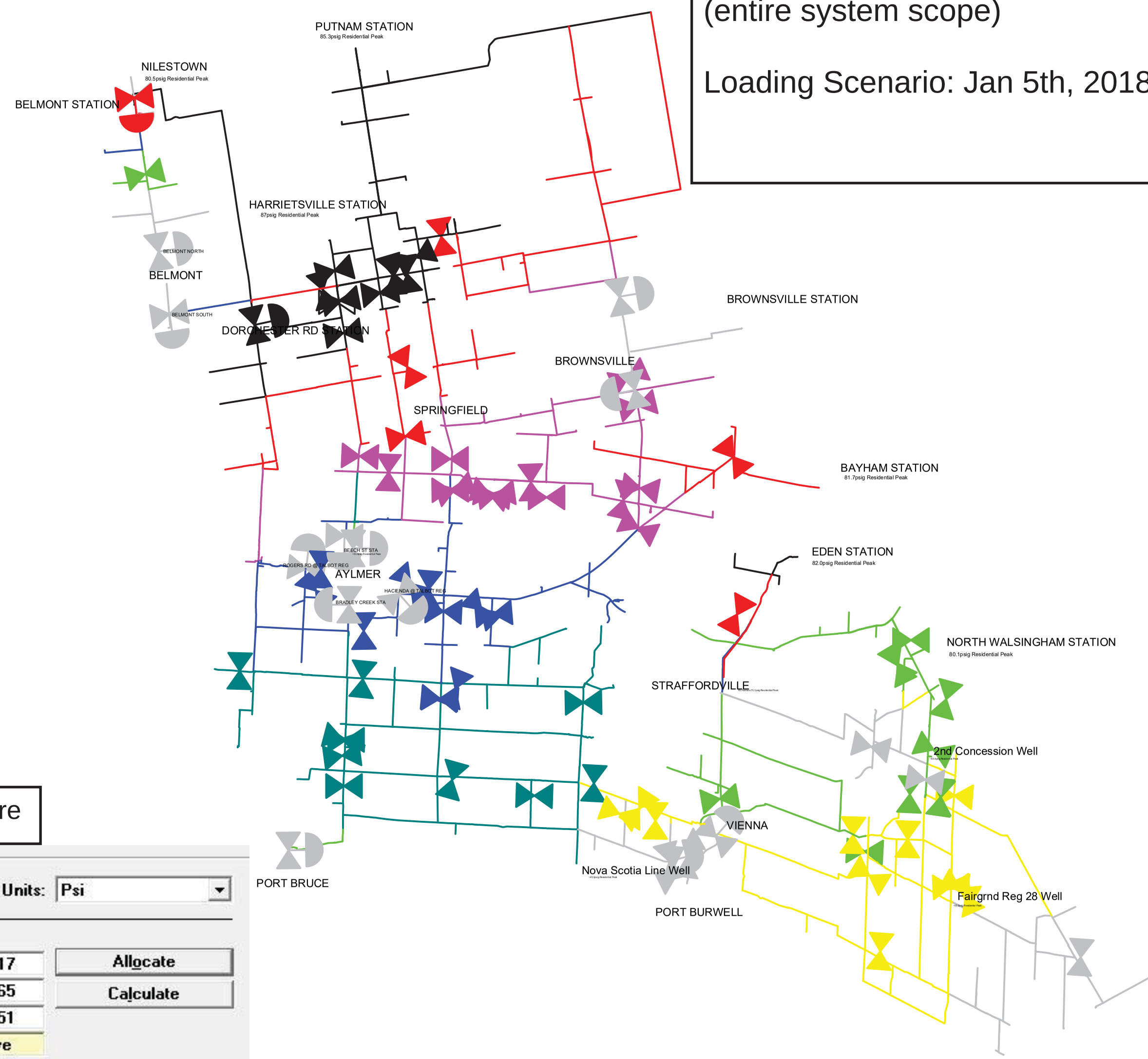
9 APPENDICES

APPENDIX A

Calibrated Base Case Model Results

Model Results: Base Case current peak (entire system scope)

Loading Scenario: Jan 5th, 2018 loading data



Color Key: Pipe Discharge Pressure

Color By Range...

Item: Pipe Pressure, Outlet   Units: Psi

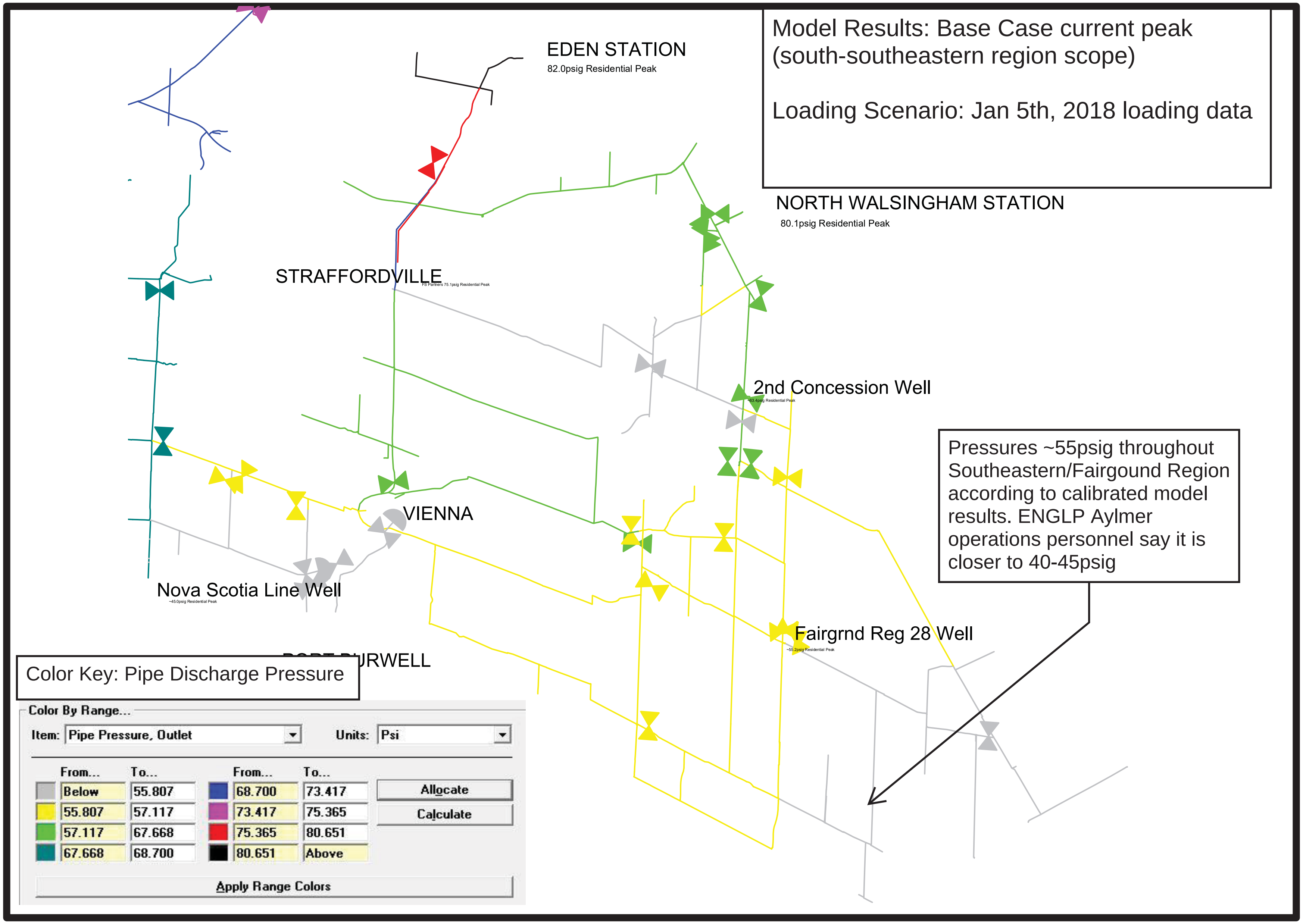
From...	To...	From...	To...
Below	55.807	68.700	73.417
55.807	57.117	73.417	75.365
57.117	67.668	75.365	80.651
67.668	68.700	80.651	Above

Allocate

Calculate

Apply Range Colors

v:\Projects\Epcor\NRG\Outside the Fence\GasWorkS\From BBB\Existing 180106 b3pe calibration 2 - Approximate Scale 1 in = 8221 Metres



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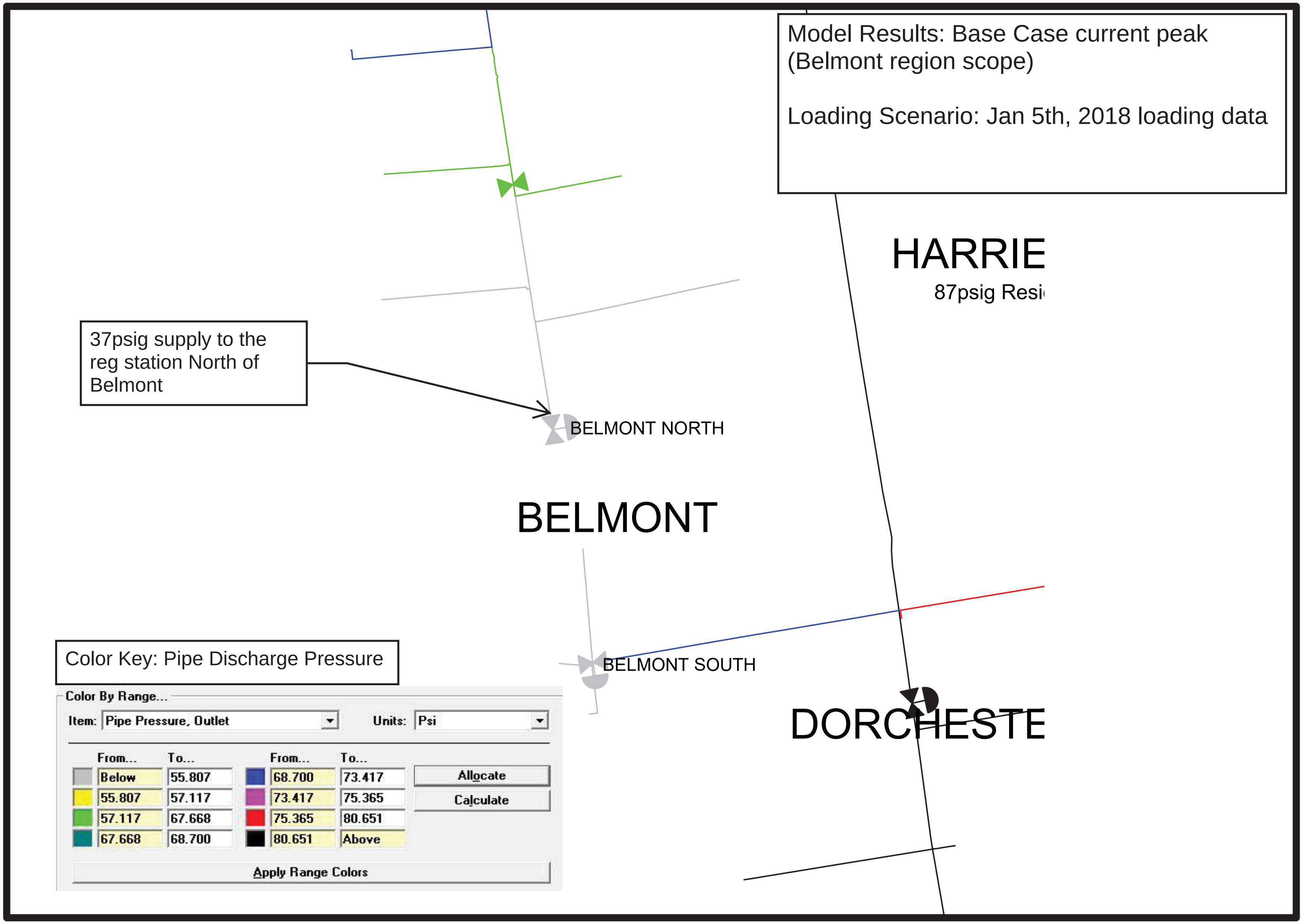


v:\Projects\Epcor\NRG\Outside the Fence\GasWorkS\From BBB\Existing 180106 b3pe calibration 2 - Approximate Scale 1 in = 1684 Metres

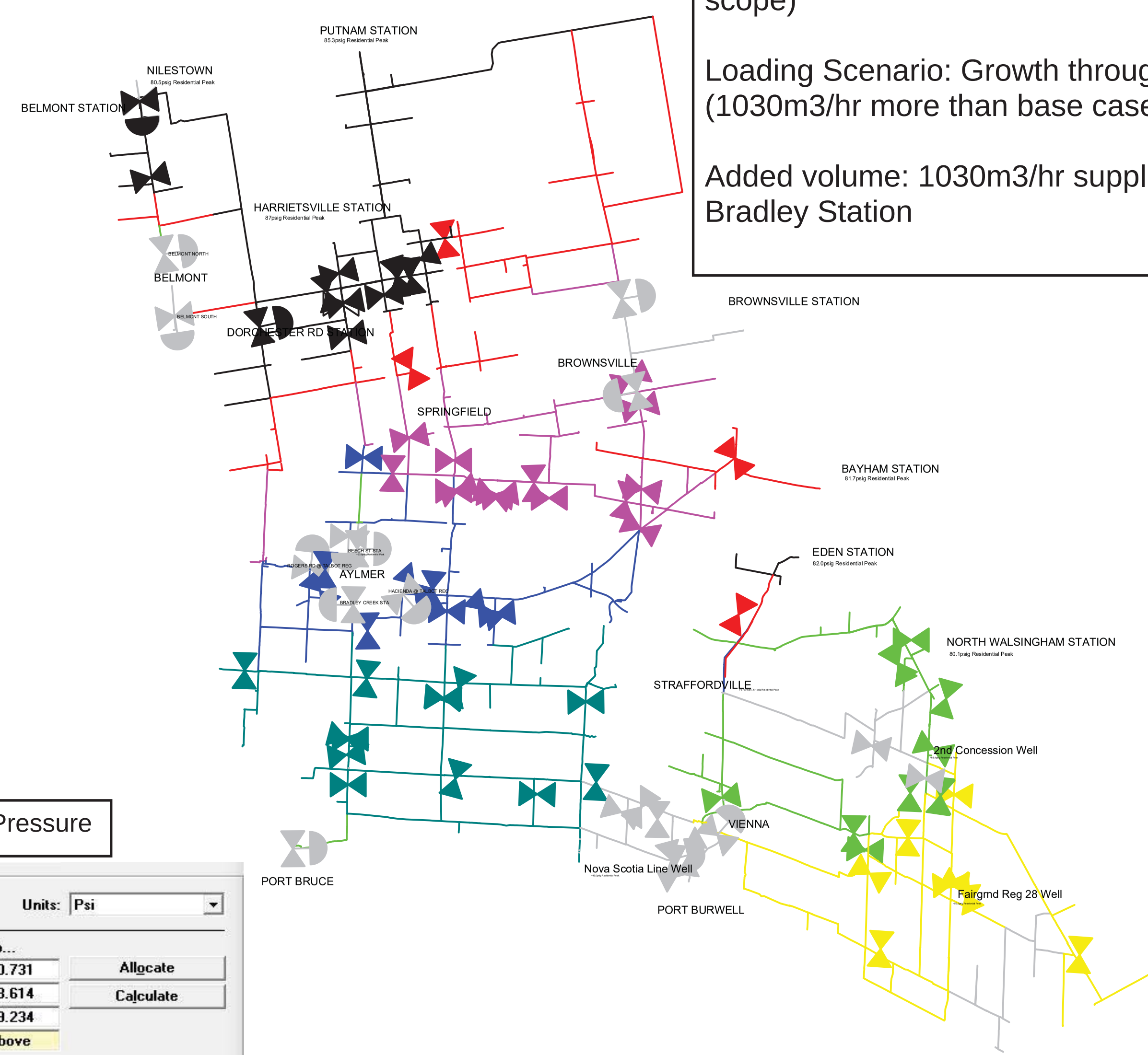
APPENDIX B

Future Growth Model Results

Model Results: Future Growth (entire system scope)

Loading Scenario: Growth through 2024 (1030m3/hr more than base case)

Added volume: 1030m3/hr supplied by Bradley Station



Color Key: Pipe Discharge Pressure

Color By Range...

Item: Pipe Pressure, Outlet   Units: Psi

	From...	To...		From...	To...
Grey	Below	49.218	Blue	64.903	70.731
Yellow	49.218	50.792	Magenta	70.731	73.614
Green	50.792	63.609	Red	73.614	79.234
Teal	63.609	64.903	Black	79.234	Above

Allocate

Calculate

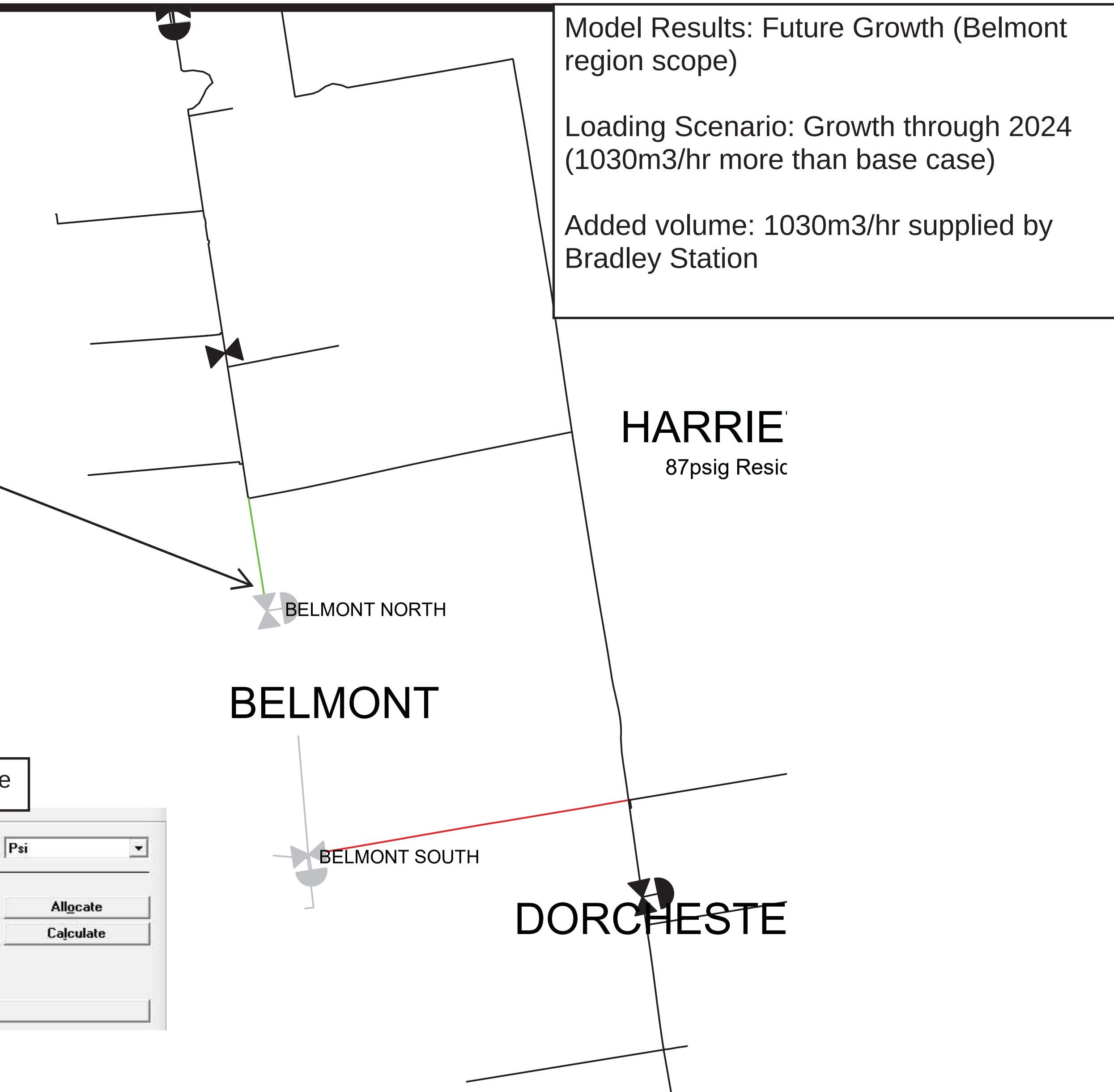
Apply Range Colors

v:\Projects\Epcor\NRG\Outside the Fence\GasWorkS\Future Growth\scenario - Approximate Scale 1 in = 8146 Metres

Model Results: Future Growth (Belmont region scope)

Loading Scenario: Growth through 2024 (1030m3/hr more than base case)

Added volume: 1030m3/hr supplied by Bradley Station



With Bradley Station supplying added volumes associated with future growth, the model predicts Belmont North could see an increase in pressure to ~51psig, up from 37psig.

Color Key: Pipe Discharge Pressure

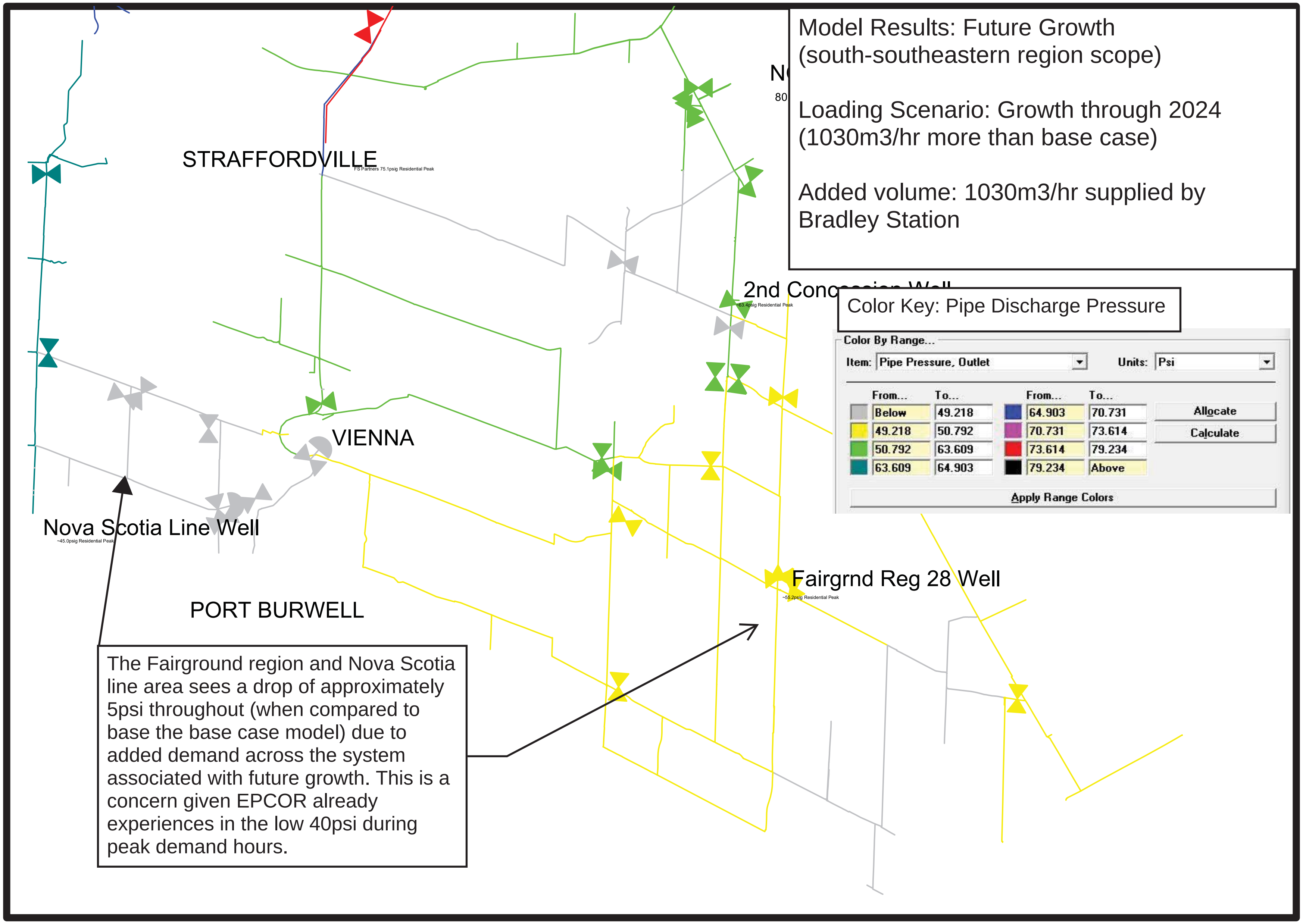
Color By Range...

Item: Pipe Pressure, Outlet — Units: Psi

	From...	To...		From...	To...
Grey	Below	49.218	Blue	64.903	70.731
Yellow	49.218	50.792	Magenta	70.731	73.614
Green	50.792	63.609	Red	73.614	79.234
Teal	63.609	64.903	Black	79.234	Above

Allocate | Calculate | Apply Range Colors

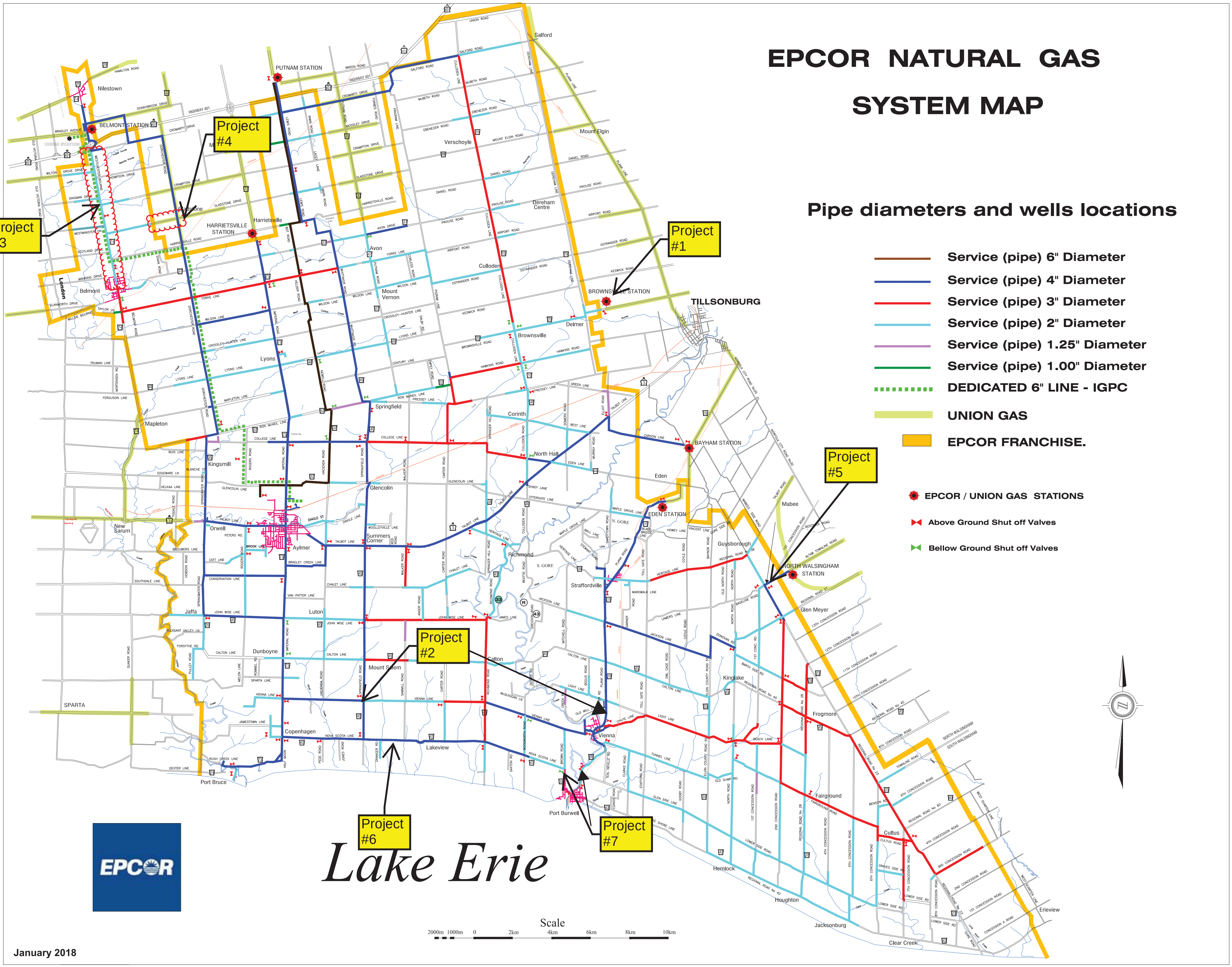
v:\Projects\Epcor\NRG\Outside the Fence\GasWorkS\Future Growth\scenario - Approximate Scale 1 in = 1932 Metres



v:\Projects\Epcor\NRG\Outside the Fence\GasWorkS\Future Growth\scenario - Approximate Scale 1 in = 3163 Metres

APPENDIX C

Infrastructure Improvement Project Key


EPCOR NATURAL GAS
SYSTEM MAP
Pipe diameters and wells locations
Service (pipe) 6" Diameter
Service (pipe) 4" Diameter
Service (pipe) 3" Diameter
Service (pipe) 2" Diameter
Service (pipe) 1.25" Diameter
Service (pipe) 1.00" Diameter
DEDICATED 6" LINE - IGPC
UNION GAS
EPCOR FRANCHISE.
EPCOR / UNION GAS STATIONS
Above Ground Shut off Valves
Bellow Ground Shut off Valves
Project #1
Project #2
Project #3
Project #4
Project #5
Project #6
Project #7
TILLSONBURG
PUTNAM STATION
BELMONT STATION
HARRIETSVILLE STATION
BROWNSVILLE STATION
BAYHAM STATION
EDEN STATION
NORTH WALSINGHAM STATION
Salford
Nilestown
Mount Elgin
Verschoyle
Dereham Centre
Harrietsville
Avon
Culloden
Mount Vernon
Delmer
Brownsville
Belmont
London
Lyons
Springfield
Corinth
Mapleton
Kingsmill
North Hall
Eden
Glencolin
Mabee
Orwell
New Sarum
Aylmer
Summers Corner
N. GORE
Guysborough
Richmond
S. GORE
Straffordville
Glen Meyer
Jaffa
Luton
Dunboyne
Calton
Mount Salem
Kinglake
Frogmore
SPARTA
Copenhagen
Vienna
Lakeview
Port Bruce
Port Burwell
Fairground
Cultus
Hemlock
Houghton
Jacksonburg
Clear Creek
Erieview
Lake Erie
EPCOR
Scale
2000m 1000m 0 2km 4km 6km 8km 10km
January 2018

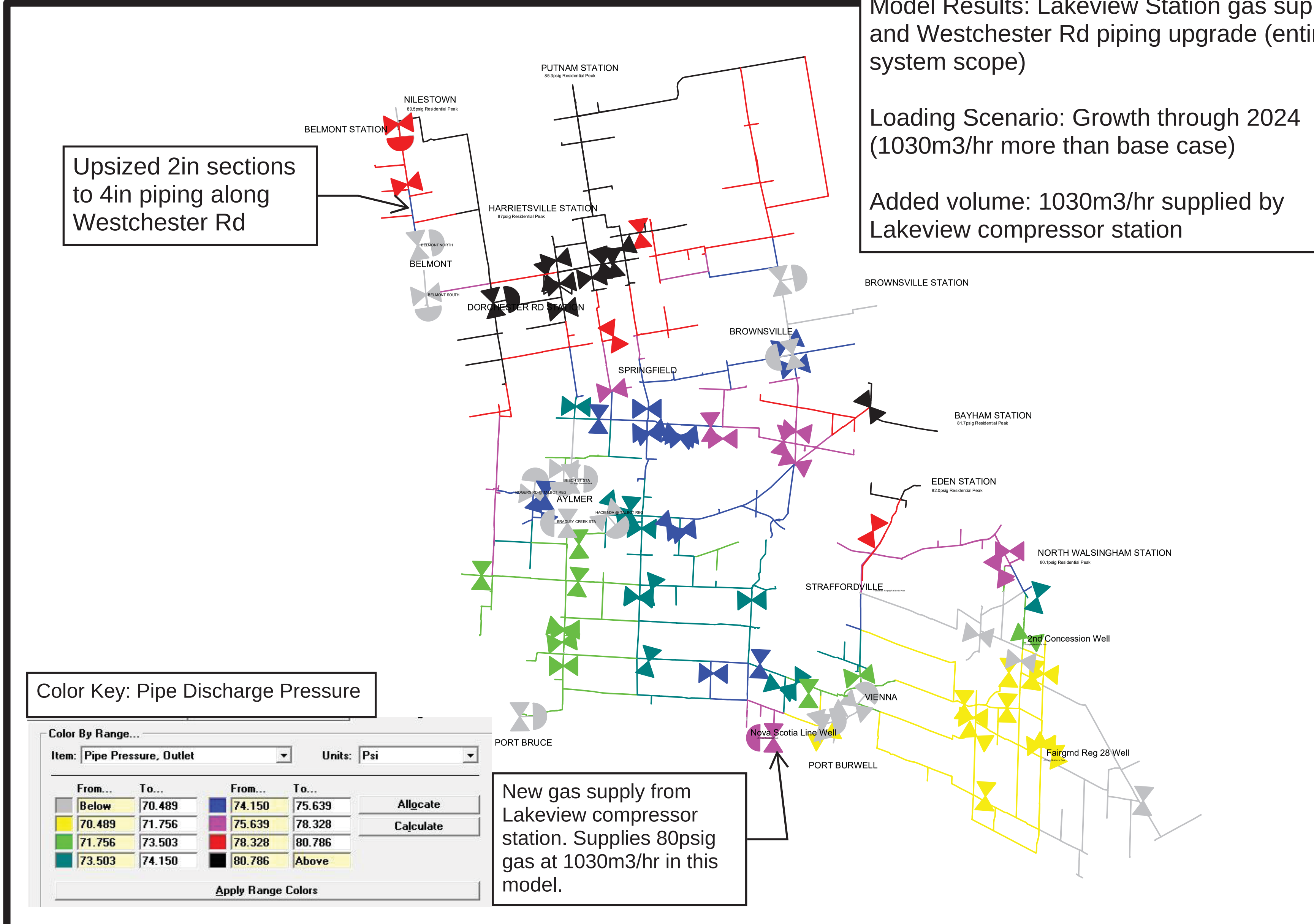
APPENDIX D

Infrastructure Improvement Projects Model Results

Model Results: Lakeview Station gas supply and Westchester Rd piping upgrade (entire system scope)

Loading Scenario: Growth through 2024 (1030m3/hr more than base case)

Added volume: 1030m3/hr supplied by Lakeview compressor station



Upsized 2in sections to 4in piping along Westchester Rd

New gas supply from Lakeview compressor station. Supplies 80psig gas at 1030m3/hr in this model.

Color Key: Pipe Discharge Pressure

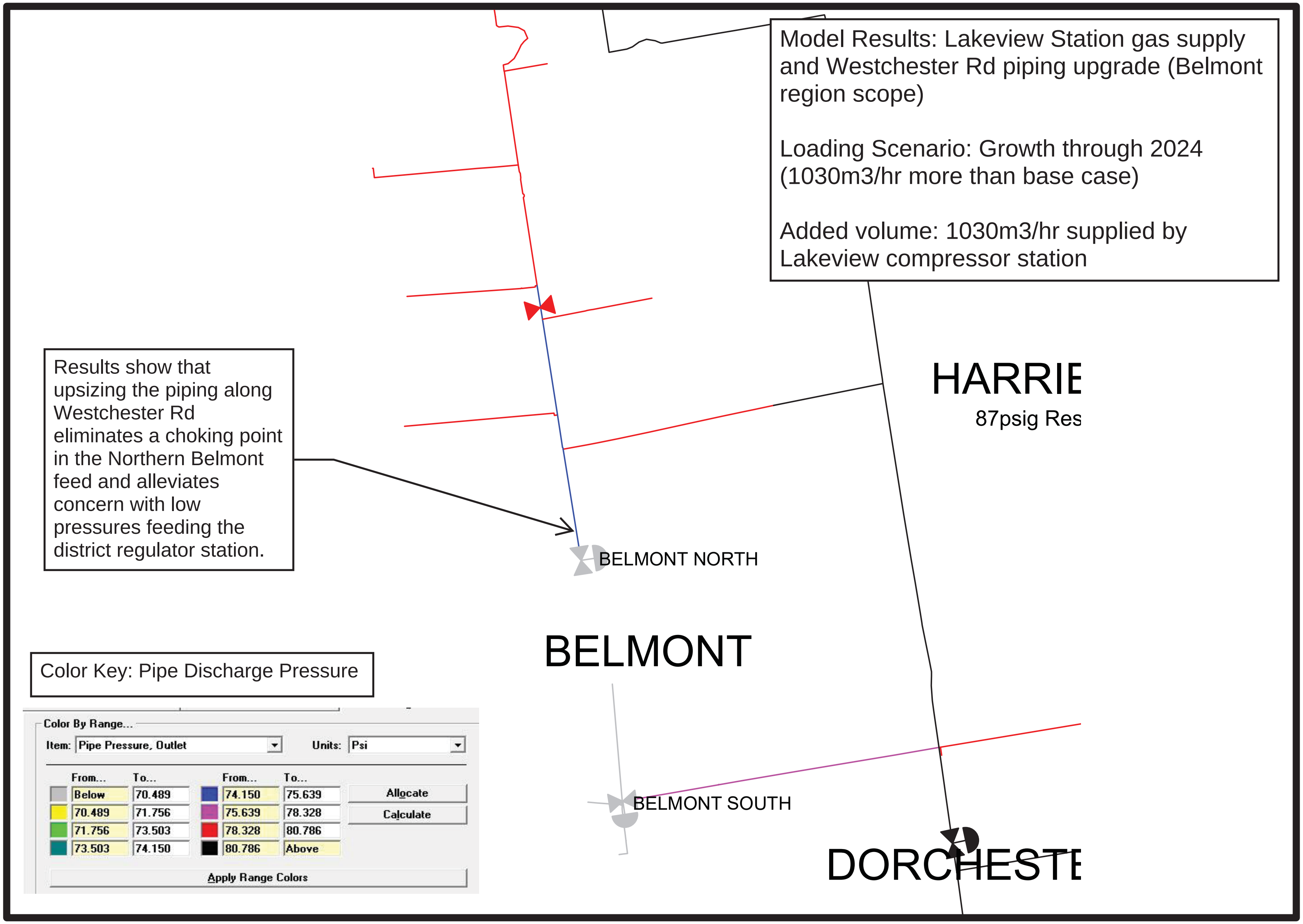
Color By Range...

Item: Pipe Pressure, Outlet — Units: Psi

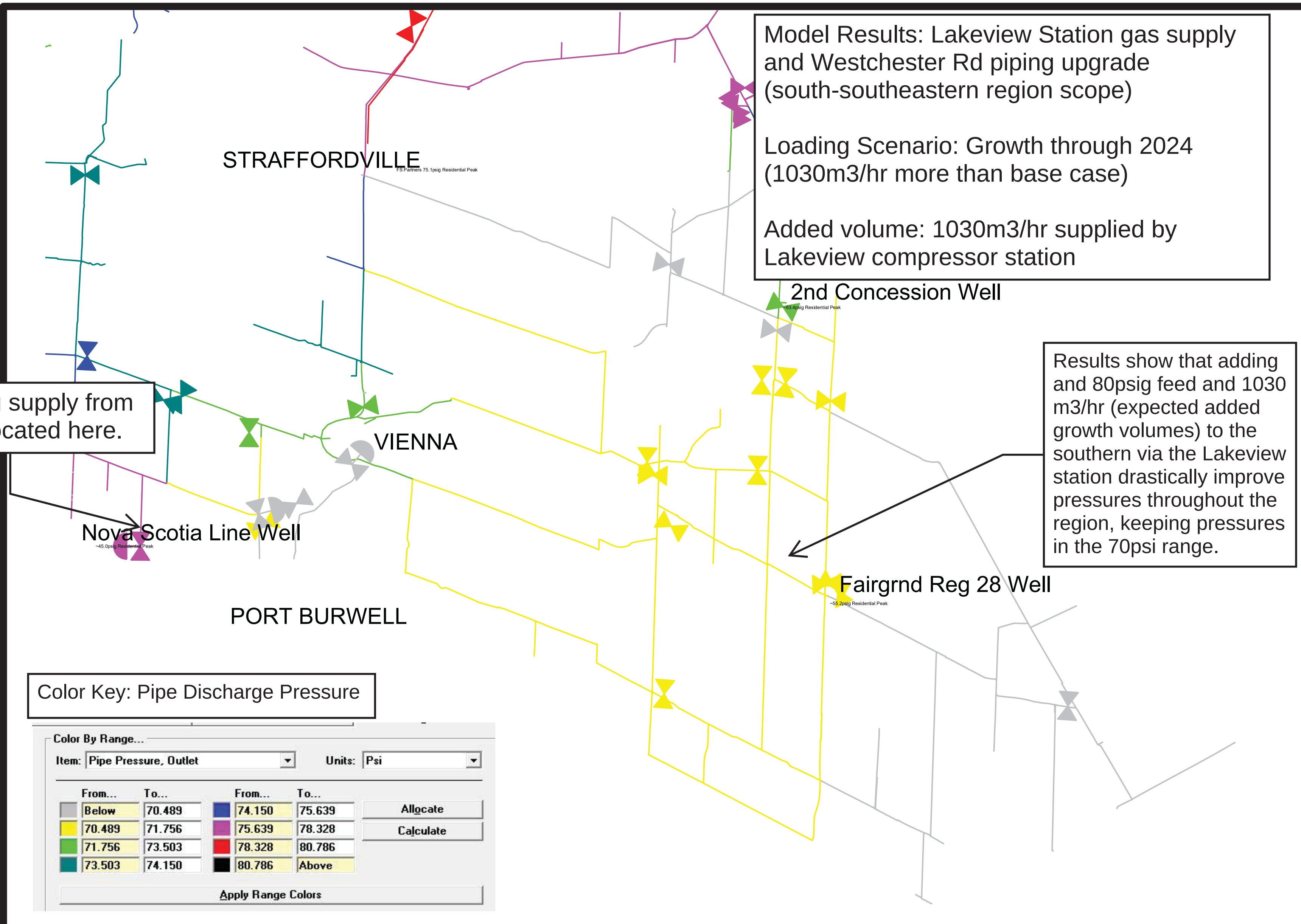
	From...	To...		From...	To...
Grey	Below	70.489	Blue	74.150	75.639
Yellow	70.489	71.756	Purple	75.639	78.328
Green	71.756	73.503	Red	78.328	80.786
Teal	73.503	74.150	Black	80.786	Above

Allocate | Calculate | Apply Range Colors

v:\Projects\Epcor\NRG\Outside the Fence\GasWorkS\Future Growth\scenario - Approximate Scale 1 in = 8146 Metres



v:\Projects\Epcor\NRG\Outside the Fence\GasWorkS\Future Growth\scenario - Approximate Scale 1 in = 1629 Metres

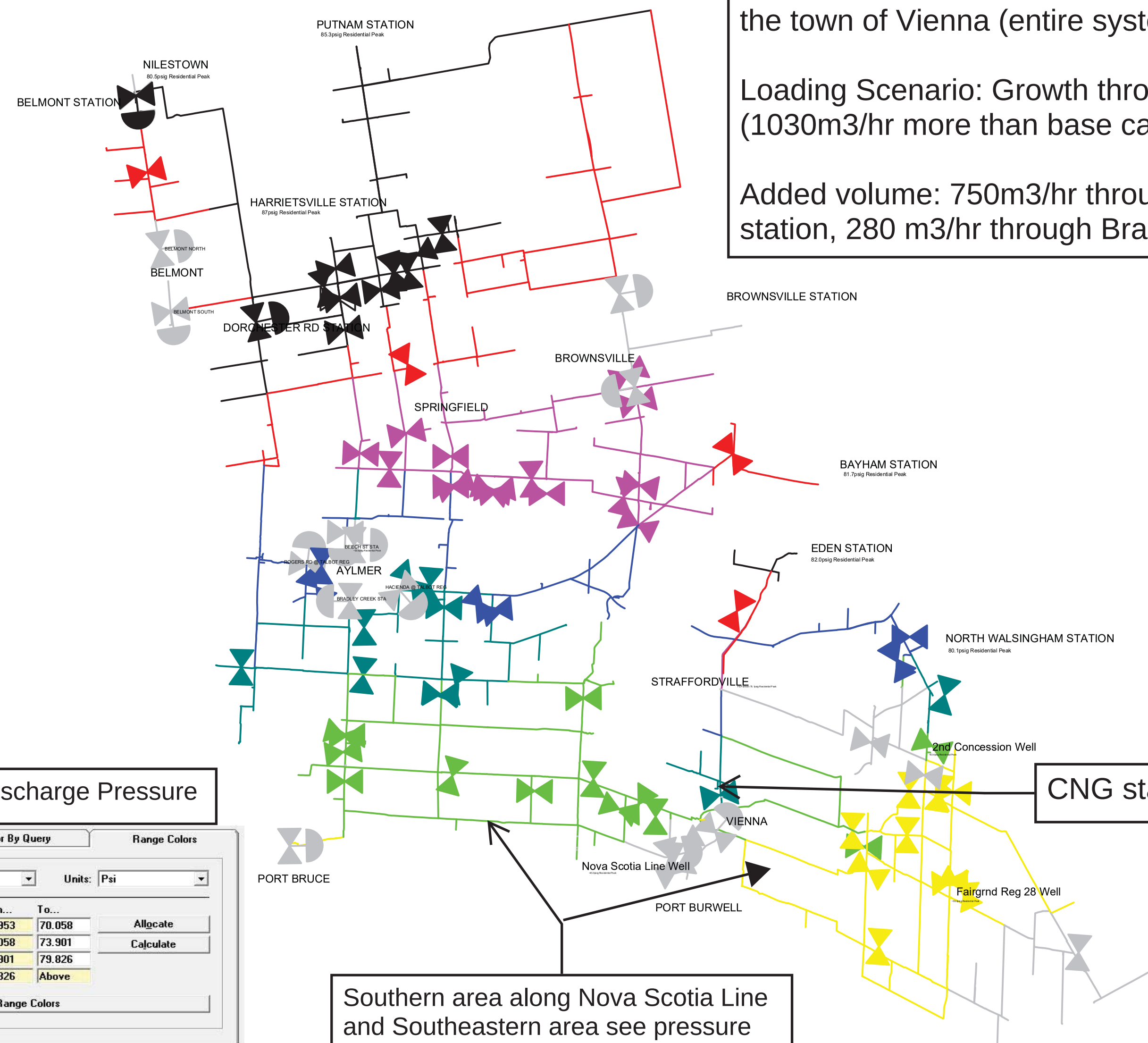


v:\Projects\Epcor\NRG\Outside the Fence\GasWorkS\Future Growth\scenario - Approximate Scale 1 in = 3168 Metres

Model Results: CNG Station Located North of the town of Vienna (entire system scope)

Loading Scenario: Growth through 2024 (1030m3/hr more than base case)

Added volume: 750m3/hr through CNG station, 280 m3/hr through Bradley Station



CNG station location

Southern area along Nova Scotia Line and Southeastern area see pressure boosts to above 58psig

Color Key: Pipe Discharge Pressure

Default Colors | Color By Query | Range Colors

Color By Range...

Item: Pipe Pressure, Outlet Units: Psi

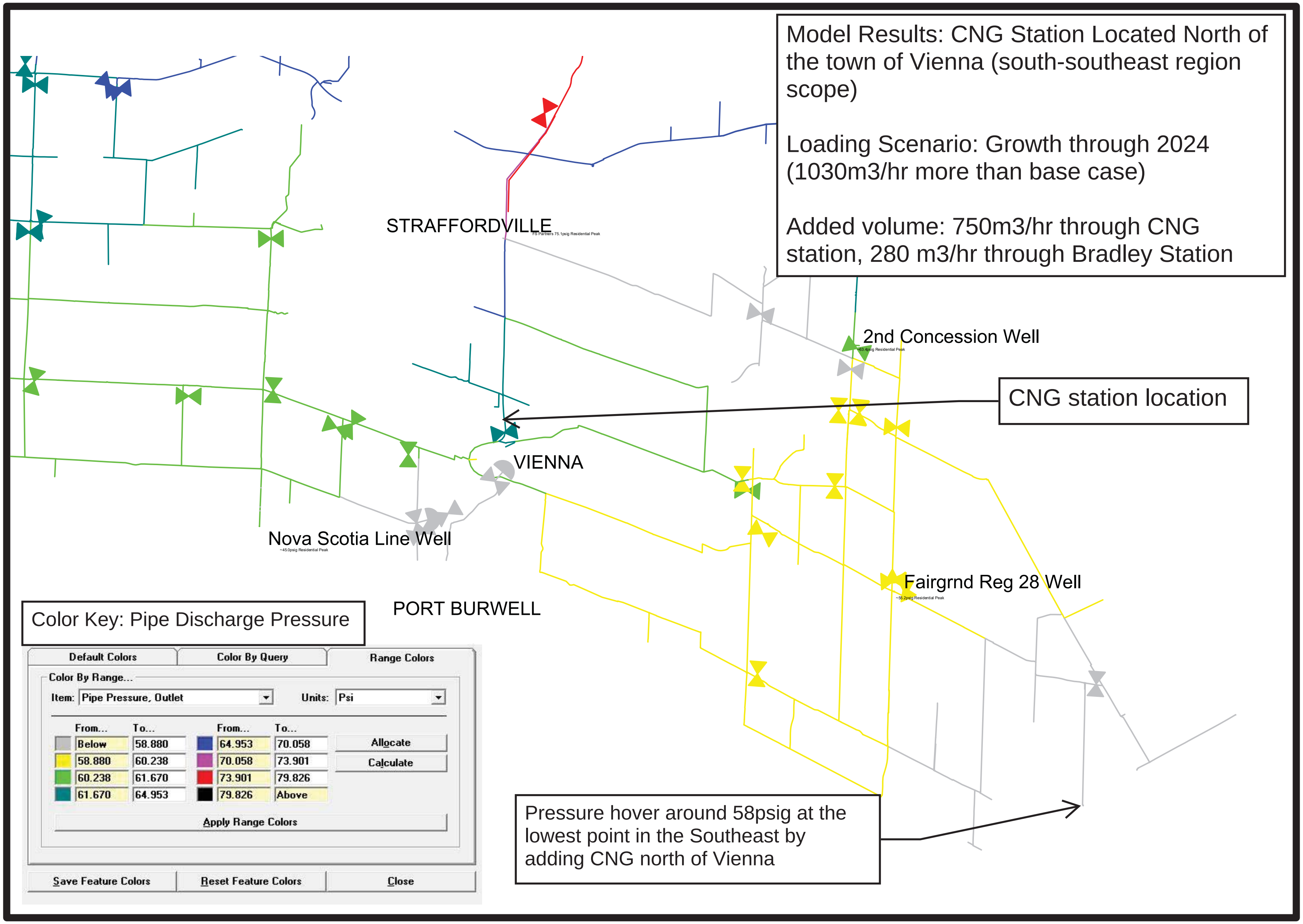
	From...	To...		From...	To...
Grey	Below	58.880	Blue	64.953	70.058
Yellow	58.880	60.238	Purple	70.058	73.901
Green	60.238	61.670	Red	73.901	79.826
Teal	61.670	64.953	Black	79.826	Above

Allocate | Calculate

Apply Range Colors

Save Feature Colors | Reset Feature Colors | Close

v:\Projects\Epcor\NRG\Outside the Fence\GasWorkS\Future Growth\scenario - Approximate Scale 1 in = 7988 Metres



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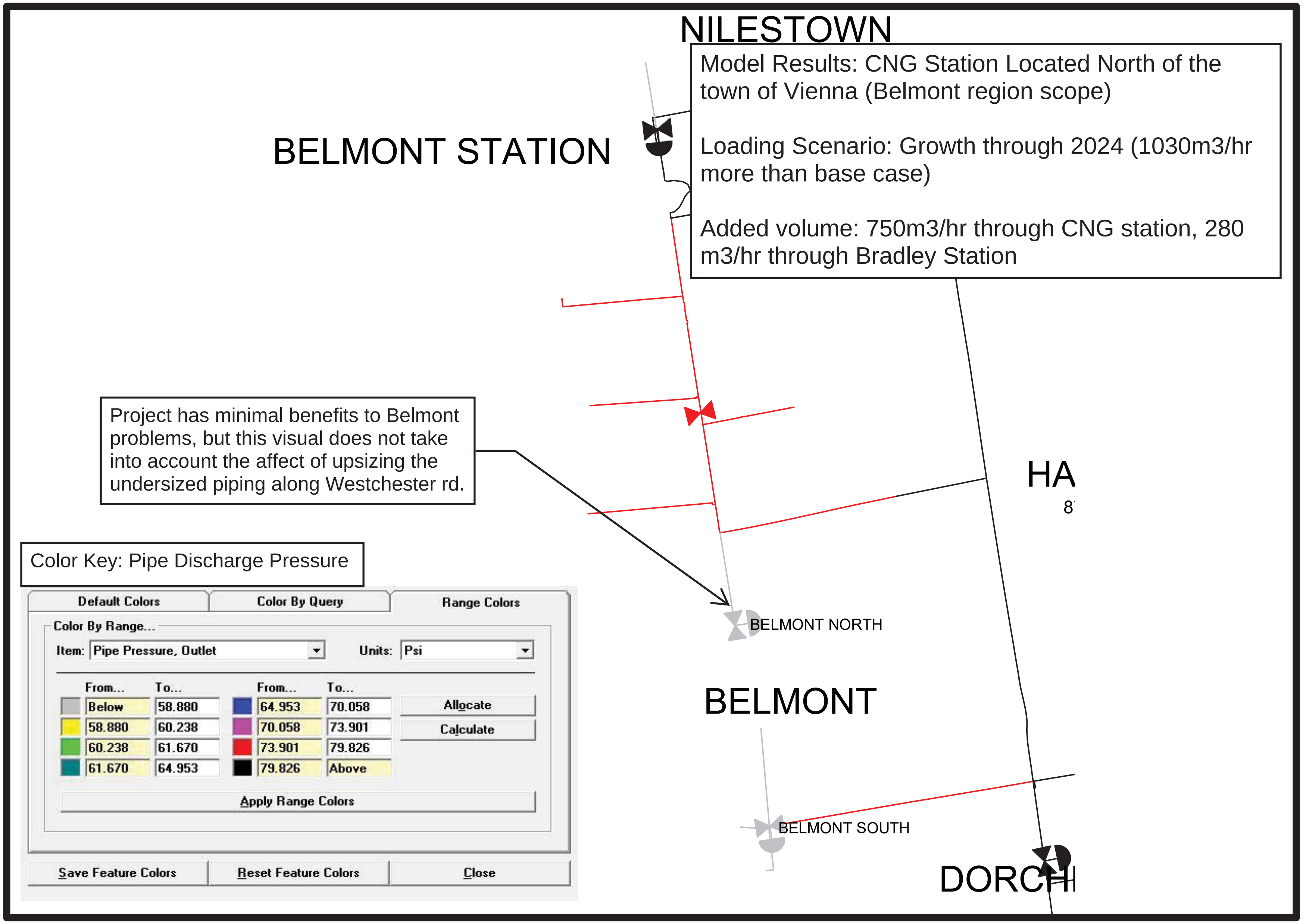

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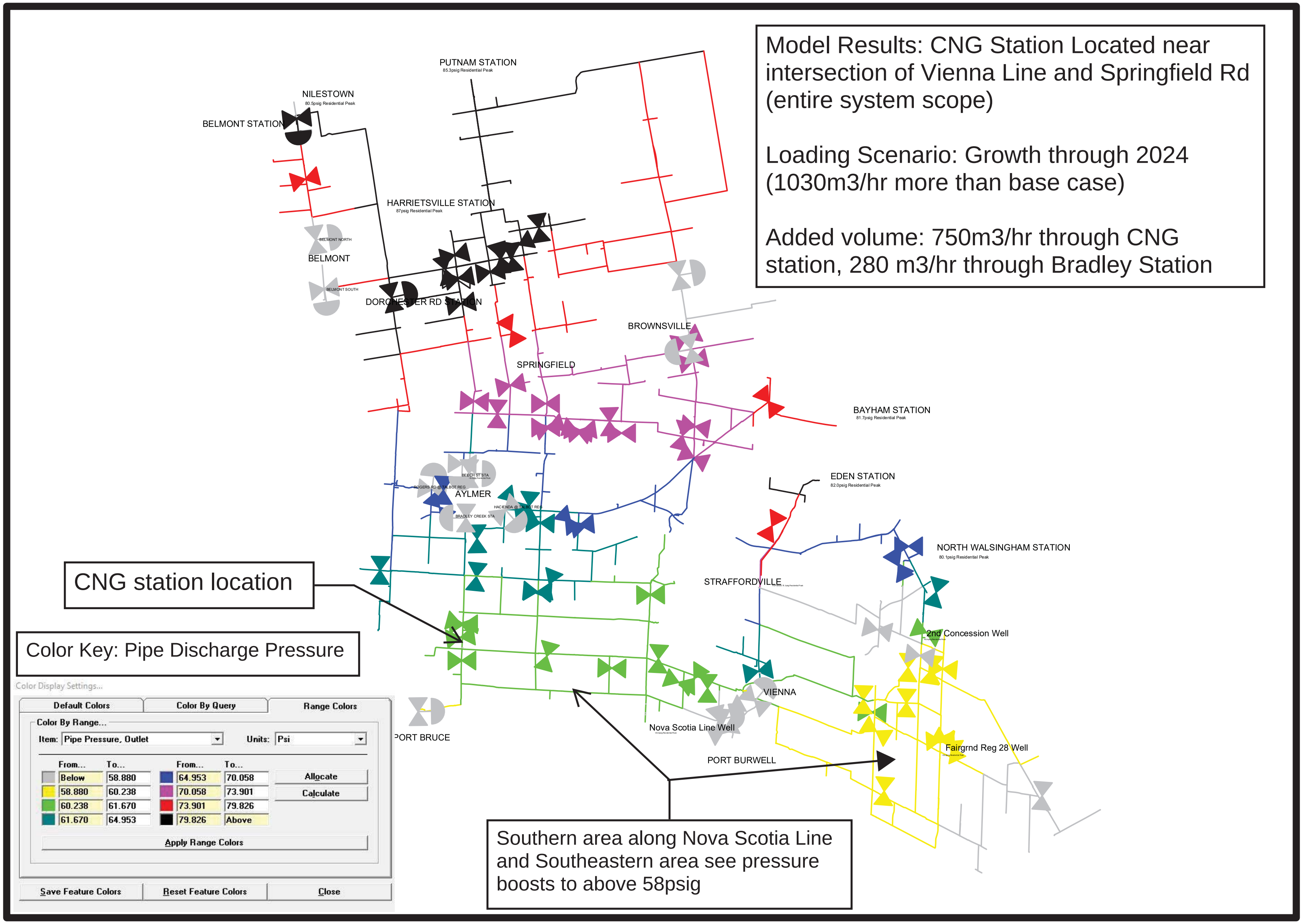

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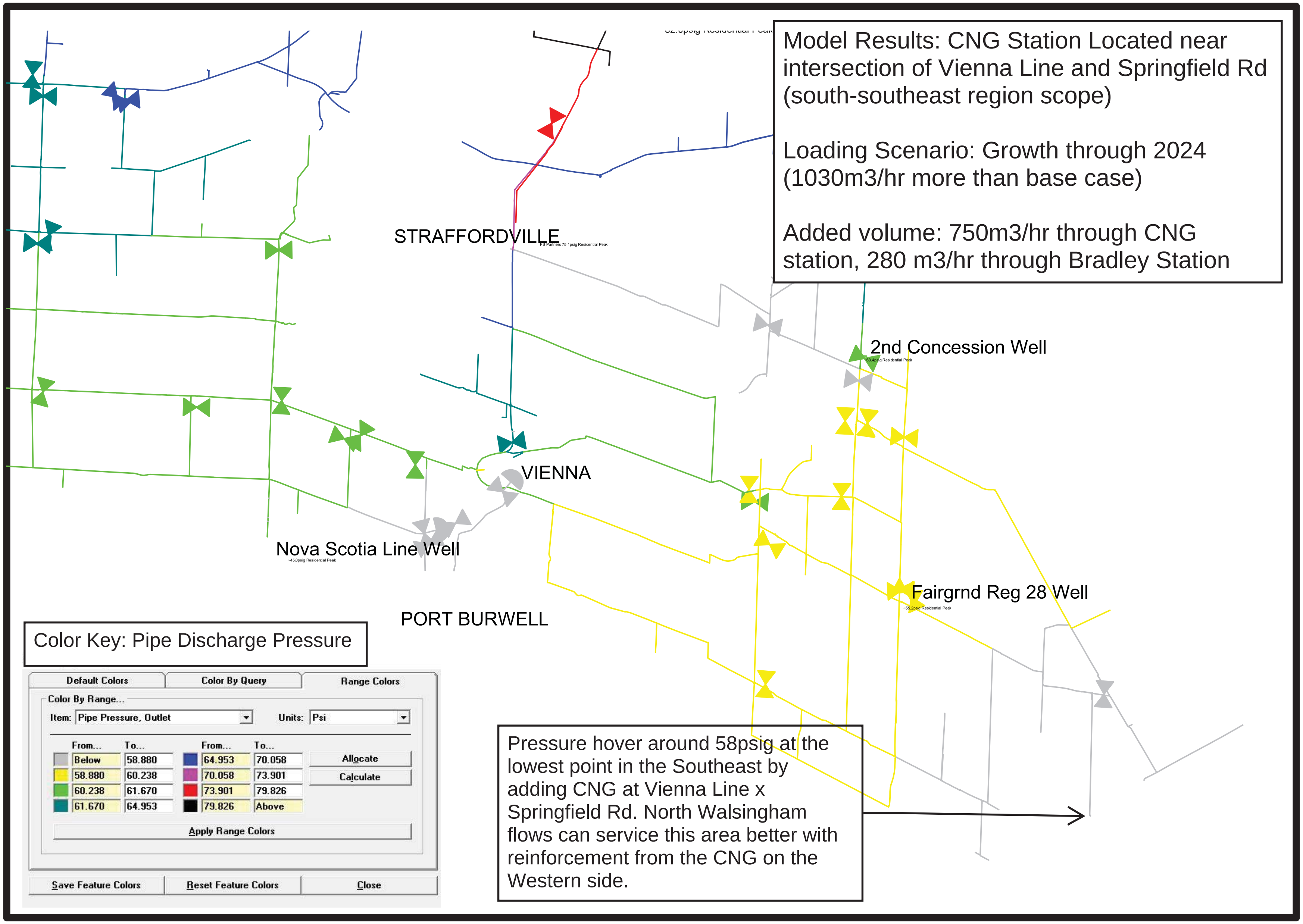

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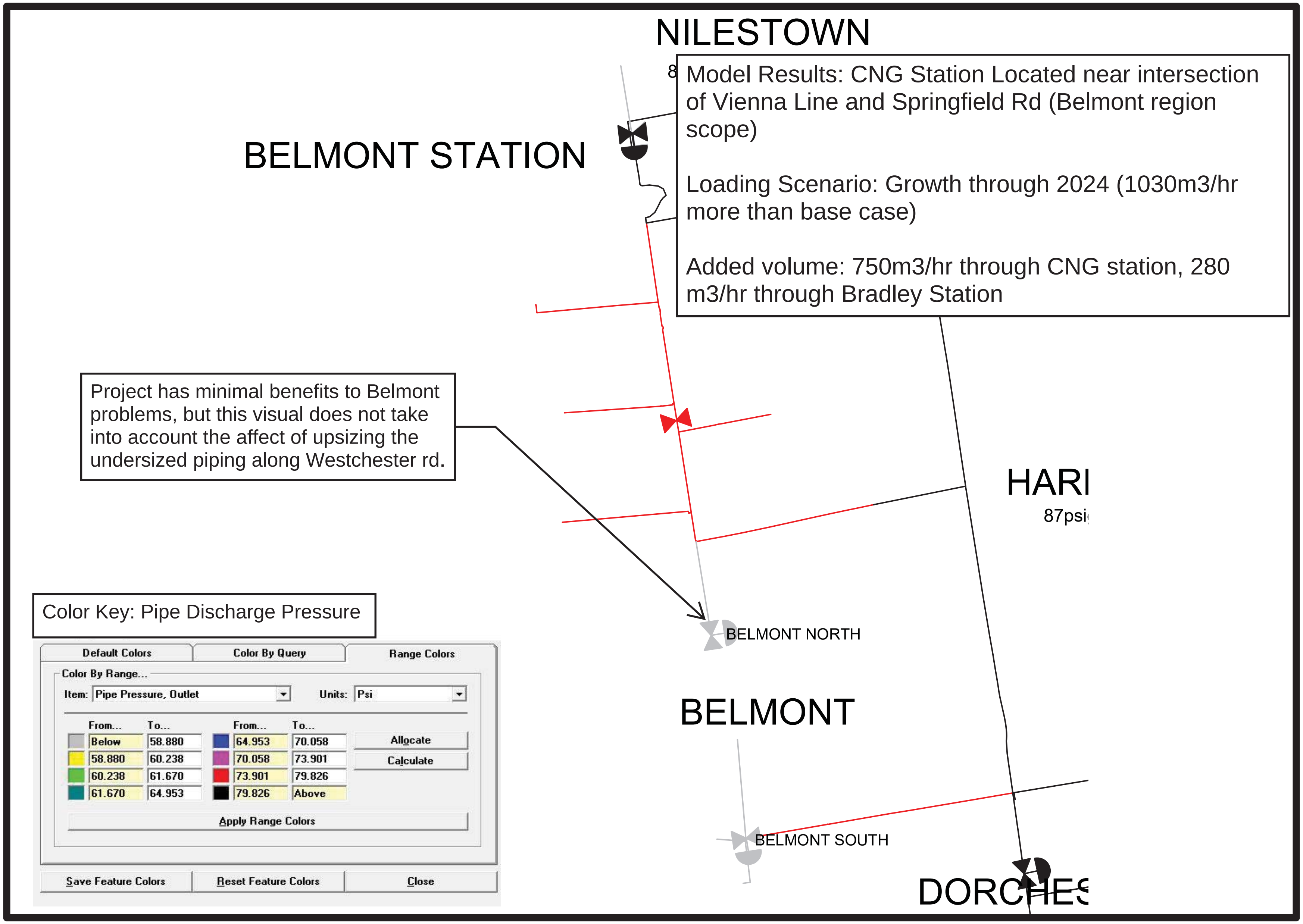

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APPENDIX E

Capital Cost Estimates (CAPEX)

Cornerstone Energy Services

Capital Cost Estimate - CNG Decanting Station

Prepared by: Travis Cushman

Date: 12/13/2018

Major Equipment Costs	Per unit	Qty	Total	Comments
CNG Let-Down Skid	$ 416,000	1	$ 416,000	Quote from Algas-SDI. Gas-heated unit.
Flame Detector	$ 4,550	1	$ 4,550	Brand - General Monitors
Security Camera(s)	$ 1,300	1	$ 1,300	
Outlet pipe, valves, fittings	$ 13,000	1	$ 13,000	
4" PE 2708 DR 11	$ 17.25	200	$ 3,450	
Tracer Wire	$ 0.35	200	$ 70	
Total Major Equipment Cost	**$**		**438,370**	
Construction Costs	**Total**			**Comments**
Site Civil/Structural	$		208,000	1/2 acre Site Development - Tree removal, grading, roadway to site and blacktop in site, fences, concrete.
Concrete	$ 1,040	37	$ 38,480	10ft x 15ft pad for skid. Two 22ft x 8ft pads for truck landing pads. Price per unit is material and install per cubic yard.
Mechanical Contractor	$		40,000	Equipment setting, above ground piping connection to skid.
Piping Contractor	$42.00	200	$ 8,400	Installation of plastic line connecting Algas let-down skid to the injection point. Used per linear meter estimation based on numbers received from EPCOR.
NDE	$		4,550	Estimated $175USD/hr 20 hours NDE.
Electrical and Instrumentation	$		65,000	Wiring for sight lighting, security camera, data monitoring, flame detector, equipment grounding.
Electrical Service	$		10,000	Service required for data monitoring devices and sight lighting. 480V service will be required if unit is to be electrically heated instead of gas-heated.
Inspection	$		31,200	Inspector for duration of construction (4 weeks). $6000USD per week.
Commissioning and Start-up	$		5,200	Two days time of an Algas-SDI technician during start-up is included in the Algas quote. Budget number is for craft support. 4 man-days @ $1000USD/day.
Total Construction Cost	**$**		**370,830**	

Other Costs	Total		Comments
			Based on experience in similar projects
Land	$	150,000	1/2 acre site near Vienna
Engineering	$	39,000	Engineering services for site design, concrete design, and piping installation for the connection to the system, wiring.
Permitting	$	10,000	
Legal Fees	$	15,000	$15,000CAD estimate was provided by EPCOR.
Total Other Costs	**$**	**214,000**	
CNG Station CAPEX	**Total**		**Comments**
Total Equipment Costs	$	438,370	
Total Construction Costs	$	370,830	
Total Other Costs	$	214,000	
ENGLP Project Management (20%)	$	204,640	Assumed ENGLP would take on the project management of this in house so PM is included in this overhead.
Contingency (20%)	$	204,640	
Total Project Cost (+/- 35%)	$	1,432,480	
USD to CAD	1.3		

Assumptions:
1.) CNG is contracted out, no CAPEX associated with acquiring the Natural Gas for this facility
2.) Estimate developed using USD estimates and converted to CAD using a factor of 1.3 per currency exchange rate as of 8/27/2018
3.) Commissioning is completed in 2 days and requires no additional support from the skid supplier or tradesmen after that.
4.) System is gas-heated. If an electrically heated unit is desired then a high voltage service is required and CAPEX would change slightly. CNG Skid cost is about the same.
5.) Electrical and Instrumentation number is assuming ENGLP would like remote data monitoring of pressures, temperatures, and flows at the site. Communication via Ethernet.
6.) Linear run of piping from the skid to the ENGLP station is based on a site 200m off of the mainline and traditional construction methods (no jack and bore, drilling, etc.)

Cornerstone Energy Services

Capital Cost Estimate - Lakeview Compressor Station Feed

Prepared by: Travis Cushman

Date: 12/13/2018

Major Equipment Costs	Per unit	Qty	Total	Comments
Filter Separator	$ 78,000	1	$ 78,000	A filter-sep with a 18" OD vessel was $85k USD for a past project.
Gas-Fired Heaters	$ 65,000	2	$ 130,000	500k BTU/hr rated heater. Need to know inlet pressure at Lakeview feed to get accurate heater sizing, or if heating is required at all.
Rotary Meter	$ 13,000	2	$ 26,000	3in Rotary pricing based on past project.
Regulators	$ 5,200	4	$ 20,800	Grove 900 TE or equivalent
Gas Chromatograph	$ 27,300	1	$ 27,300	ABB Brand GC - quote from past project
Instrument shelter	$ 15,000	1	$ 15,000	Spectra Spec EGM Building quote from past project
Instrumentation	$		10,400	Mercury mini-max instrumentation for pressure and temperature data info and two Rosemount 3051 PT.
Piping, manual valves, fittings	$ 65,000	1	$ 65,000	Balance of plant piping, isolation valves, fittings
4" PE 2708 DR 11	$ 17.25	1600	$ 27,600	
Tracer Wire	$ 0.35	1600	$ 560	
Total Major Equipment Cost	**$**		**182,260**	

Construction Costs			Total	Comments
Site Civil/Structural	$		120,000	1/4 acre Site Development - Tree removal, grading, roadway to site and blacktop in site, fences, drainage. Including concrete equipment pads.
Skid fabricator	$		100,000	Mechanical and instrumentation
NDE	$		5,000	Two days of fabrication NDE.
Field Electrical	$		25,000	New service, power hookups to skid, field wiring, junction box installation, lighting, grounding
Site Mechanical Contractor	$		100,000	Equipment and skid placement and interconnecting piping.
Inspection	$		7,800	One week total for both fab shop and field inspection.
Commissioning and Start-up	$		11,700	Tradesmen and technicians.
Pipeline Contractor	$ 42.00	1600	$ 67,200	Priced per linear foot
Total Construction Cost	**$**		**436,700**	

Other Costs	Total		Comments
			Based on experience in similar projects
Land	$	100,000	Leasing land from the supplier or parcel close to the supply point on Gully Rd
Engineering	$	100,000	Engineering services from concept to completion of stamped drawings
Permitting	$	10,000	
Legal Fees	$	15,000	$15,000 CAD estimate was provided by EPCOR.
Total Other Costs	**$**	**225,000**	
Meter-Regulator Station CAPEX	**Total**		**Comments**
Total Equipment Costs	$	182,260	
Total Construction Costs	$	436,700	
Total Other Costs	$	225,000	
ENGLP Project Management (20%)	$	168,792	Assumed ENGLP would take on the project management of this in house so PM is included in this overhead.
Contingency (20%)	$	168,792	
Total Project Cost (+/- 35%)	$	1,181,544	
USD to CAD	1.3		
		$843,960.0	

Assumptions:
1.) Numbers reflect cost to input a meter-regulator station either at the lake supply point in Project #7 along Nova Scotia Line or just outside of Glen Meyer at the intersection of Concession 1/Baseline.
2.) Estimate developed using USD estimates and converted to CAD using a factor of 1.3 per currency exchange rate as of 8/27/2018
3.) Equipment estimates taken from past projects so pressure rating and sizes of referenced items may not match needs for this particular station.
4.) Filtration and/or heat may not be required depending on quality and Lakeview supply pressure but it is included in this estimate.
5.) Estimate assumes ENGLP is responsible for the cost of installing metering equipment.
6.) Skidding piping for the meter-regulator process.

Cornerstone Energy Services

Capital Cost Estimate - Westchester Rd Piping Upsize	
Prepared by:	Travis Cushman
Date:	12/13/2018

Major Equipment Costs	Per unit	Qty	Total	Comments
4" PE 2708 DR 11	$17.25	5,000	$ 86,250	Needed 4720m, ordering 5000m Piping estimated from budgetary quote from C.R. Wall & Co.
Tracer Wire	$ 0.35	5000	$ 1,750	
Total Major Equipment Cost	**$**		**88,000**	
Construction Costs	**Total**			**Comments**
Mechanical and Piping	$42.00	4,720	$ 198,240	Installation of plastic line section along Westchester Bourne. Per meter INSTALLATION estimation from EPCOR as $42 given the difficulty of installation expected and having to cross existing services.
Service re-locations	$1,000.00	31	$ 31,000	Re-locate services on existing 2in line to the new 4in line after it has been pressure tested and brought online.
Total Construction Cost	**$**		**229,240**	
Other Costs	**Total**			**Comments** Based on experience in similar projects
Land	$		-	No land purchase required.
Survey	$		6,500	Minimal survey effort required as it is assumed this pipeline would go in an existing trench.
Engineering	$		13,000	GIS mapping edits & tie-in details.
Permitting	$		5,000	
Legal Fees	$		-	No legal fees assumed with this project.

Total Other Costs	**$**	**24,500**	
Pipeline Replacement CAPEX	**Total**		**Comments**
Total Equipment Costs	$	88,000	
Total Construction Costs	$	229,240	
Total Other Costs	$	24,500	
ENGLP Project Management (20%)	$	68,348	Assumed ENGLP would take on the project management of this in house so PM is included in this overhead.
Contingency (20%)	$	68,348	Contingency estimate may be a bit high for this type of estimation as it is a pretty straight forward project.
Total Project Cost (+/- 35%)	$	478,436	
USD to CAD	1.3		

Assumptions:
1.) Estimate developed using USD estimates and converted to CAD using a factor of 1.3 per currency exchange rate as of 8/27/2018
2.) Construction is traditional methods (no jack and bore or drilling) in the public right of way, using the existing trench ENGLP occupies.
3.) Per unit cost of piping is a conservative number and may decrease given that this single order is a large amount of pipe.
4.) Service relocations assume less than 2m additional service size piping.

APPENDIX F

Lakeview Compressor Station Pipeline Calculations

Pipe Flow Calculation: Lakeview Compressor Station Feed

Project Identification:
Prepared By: TBC
Reviewed By:

Calculation Data/Results...

Flow Equation: Institute of Gas Technology - Improved

Pipe Size/Type: 4P-S11
Inside Diameter: 3.682 Inches
Inside Wall Roughness: 0.000060 Inches

Length: 1600 Meters
Efficiency: 0.95 Decimal
Flow Rate: 1700 m3/hr

	Inlet (Upstream) Values...	Outlet (Downstream) Values...
Pressure:	80.00 Psi	70.03 Psi
Elevation:	0 Feet	0 Feet
Temperature:	5.0 C	4.6 C

Heat Loss Or Gain Calculation Method: None

Joules-Thomson Cooling Was Included

Linear Pressure Drop: 9.97 Psi
Minimum/Maximum Velocity: 33.3 / 37.1 Feet/sec
Line Volume At Average Pressure: 70.750 M3
Average Pressure: 75.11 Psi
Velocity Limit: 200.0 Feet/sec

Compressibility Factor (Base): 0.985
Average Compressibility: 0.985
Calculation Method: AGA8-92-Detailed

Gas Properties...

Base Pressure: 14.730 Psi (Abs)
Base Temperature: 60.000 Fahrenheit

Specific Gravity: 0.58
Viscosity: 0.000007 Lbm/Ft-sec

Assigned Gas Properties File: aga8_92_gcoast.prp

Atmospheric Pressure: 14.732 Psi (Abs)
Atmospheric Pressure Method: American Gas Association (AGA)

Compressibility Factor: 1
Compressibility Factor Method: AGA8-92-Detailed

Calculation Notes...

The Outlet (Downstream) Pressure value was calculated.
The Outlet (Downstream) Temperature was calculated.

Report: Continued...

Comments:

These calculations are only valid within the applicabile range of the selected flow equation.

Temperature calculations are only valid within the applicabile range of the selected method.

Temperature calculations based on Joule-Thomson Cooling are approximate and only valid for high methane content natural gas.

The Minimum Velocity value is based on the larger of the inside diameter value of the specified pipe Size/Type and any attached components, and the Inlet Pressure and AverageTemperature values.
The Maximum Velocity value is based on the smaller of the inside diameter value of the specified pipe Size/Type and any attached components, and the Outlet Pressure and Average Temperature values.

References:

Flow Equation - Gas Age Magazine, May 1967, Gas Behavior In Distribution Systems.
Compressibility - American Gas Association, Report No.8, 1992.
Atmospheric Pressure - American Gas Association, GEOP Series, Measurement, Book M-1, 1993.
Temperature Calculation - Derived. See Calculation Reference For Documentation.

Notes:

80# MAOP system, New 4in plastic line.

THIS IS EXHIBIT "G" REFERRED TO IN THE AFFIDAVIT OF BRIAN LIPPOLD SWORN ON DECEMBER 4, 2019.

Commissioner for Taking Affidavits

DANIEL S. J. BANGARTH
Barrister, Solicitor, Notary Public
562 Waterloo Street
London, Ontario N6B 2P9
Ph (519) 472 2340 | Fax (519) 657 8173

[redacted]

From: [redacted] on behalf of [redacted]
Sent: Tuesday, May 5, 2015 8:35 AM
To: Brian Lippold
Subject: Natural gas

I am very interested in natural gas distribution to my area. I would surely use natural gas if it was available In dereham center. It would save me money and is a cheaper, better, cleaner fuel source than oil or propane that I've used since buying my house. Looking forward to seeing natural gas available in my area.

Thank you
[redacted]

[redacted]

From: [redacted]
Sent: Monday, June 8, 2015 2:53 PM
To: Brian Lippold
Subject: Natural Gas

This email is in regard to the possibility of having a natural gas service to our farm. We feel there would be a great financial advantage to our cash crop operation because propane costs can exceed $9000.00 in grain dying alone. Our farmhouse is heated with corn and the workshop with oil.There would also be savings to heat them and it would be nice to have everything on one fuel.

Thanks, [redacted]

[redacted]

Mossley Ont.

N0L 1V0

[redacted]

From: [redacted]
Sent: Monday, April 27, 2015 5:18 PM
To: Brian Lippold
Subject: Natural Gas Service

Hi Brian,

We are very much interested in Natural Gas service being provided to us.
Our current house and shop heating is with electrically heated hot water. Hot water being circulated through shop floor, and through air handler.
A Natural Gas hot water heating system, or furnace would be a lot more effective for heating the house and shop, as well as household needs.
It would be a lot less stress on the electric grid, and expected more economical.
Many thanks

[redacted]

[redacted] Mount Elgin, Ontario
Canada, N0J 1N0

[redacted]

THIS IS EXHIBIT "H" REFERRED TO IN THE AFFIDAVIT OF BRIAN LIPPOLD SWORN ON DECEMBER 4, 2019.

Commissioner for Taking Affidavits

DANIEL S. J. BANGARTH
Barrister, Solicitor, Notary Public
562 Waterloo Street
London, Ontario N6B 2P9
Ph (519) 472 2340 | Fax (519) 657 8173

Presentation to:

Southwest Oxford

Presentation By:

Brian Lippold, General Manager

NATURAL RESOURCE GAS Ltd

November 3, 2015

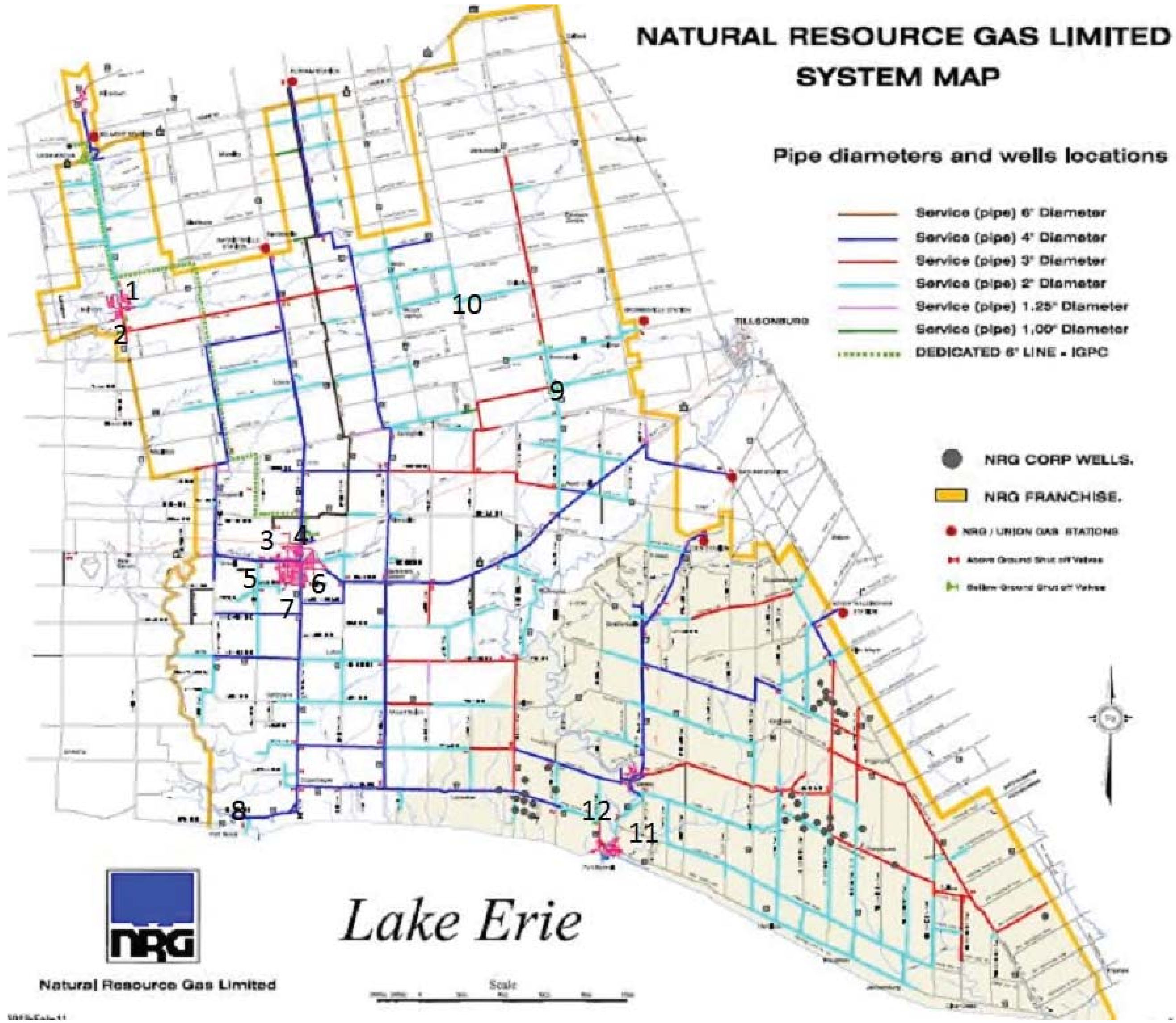
About NRG Ltd

- Nearly 100 years old, NRG was first know as Dominion Gas. It then became the Medina Gas Co. Medina was rescued from bankruptcy in the mid 70s by prominent local businessman, Anthony Graat.

- NRG now has 8500 Customers.

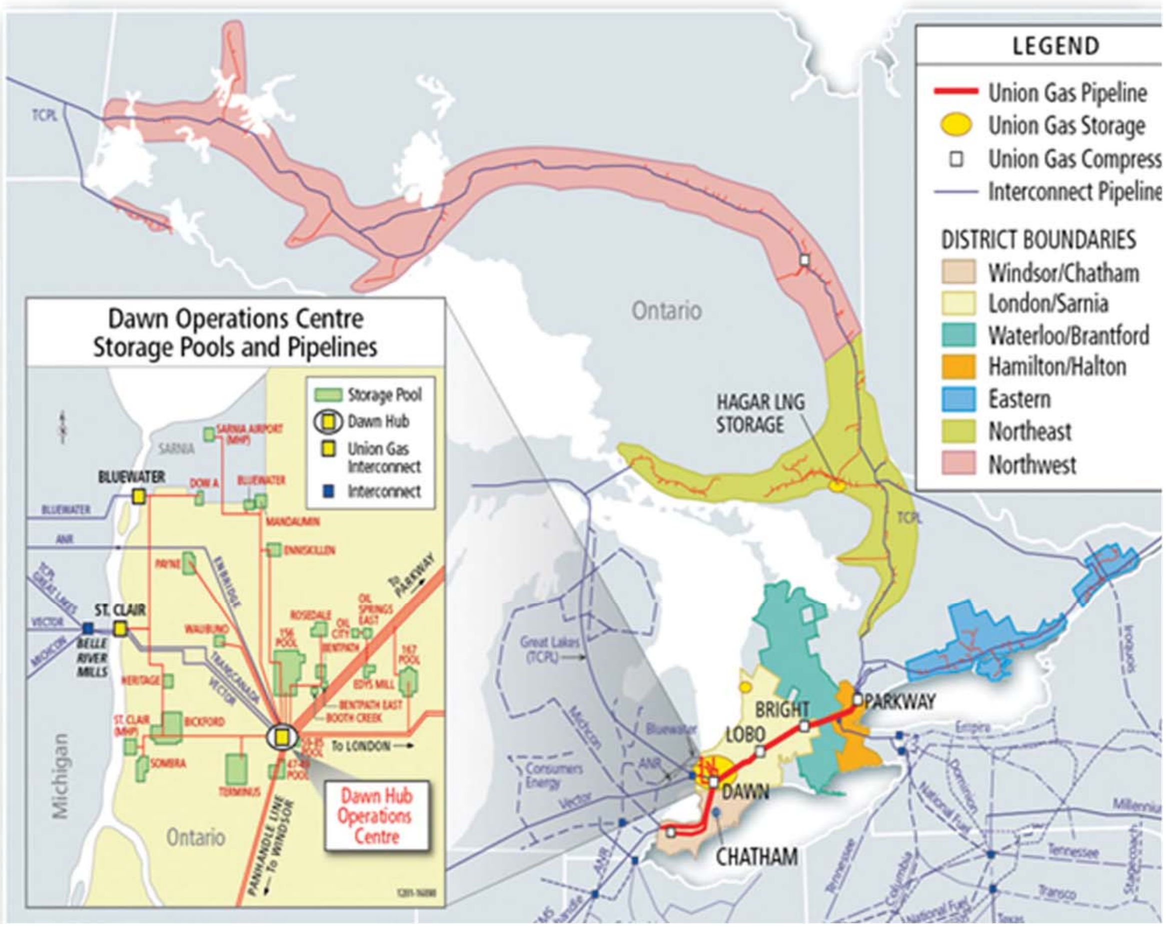
- NRG has a franchise area defined by franchise agreements
- Within NRGs franchise area, there is enough Gas line if combined to run from the Grand backs to Victoria Island.

- Rates
  - Regulated by Ontario Energy Board
  - Economy of scales
  - Storage is the differentiator
  - Fracking = 400 years worth of NG = price stability
  - Rumours by propane and oil providers


NATURAL RESOURCE GAS LIMITED
SYSTEM MAP
Pipe diameters and wells locations
Service (pipe) 6" Diameter
Service (pipe) 4" Diameter
Service (pipe) 3" Diameter
Service (pipe) 2" Diameter
Service (pipe) 1.25" Diameter
Service (pipe) 1.00" Diameter
DEDICATED 6" LINE - IGPC
NRG CORP WELLS.
NRG FRANCHISE.
NRG / UNION GAS STATIONS
Above Ground Shut off Valves
Below Ground Shut off Valves
TILLSONBURG
1
2
3
4
5
6
7
8
9
10
11
12
Lake Erie
NRG
Natural Resource Gas Limited
Scale

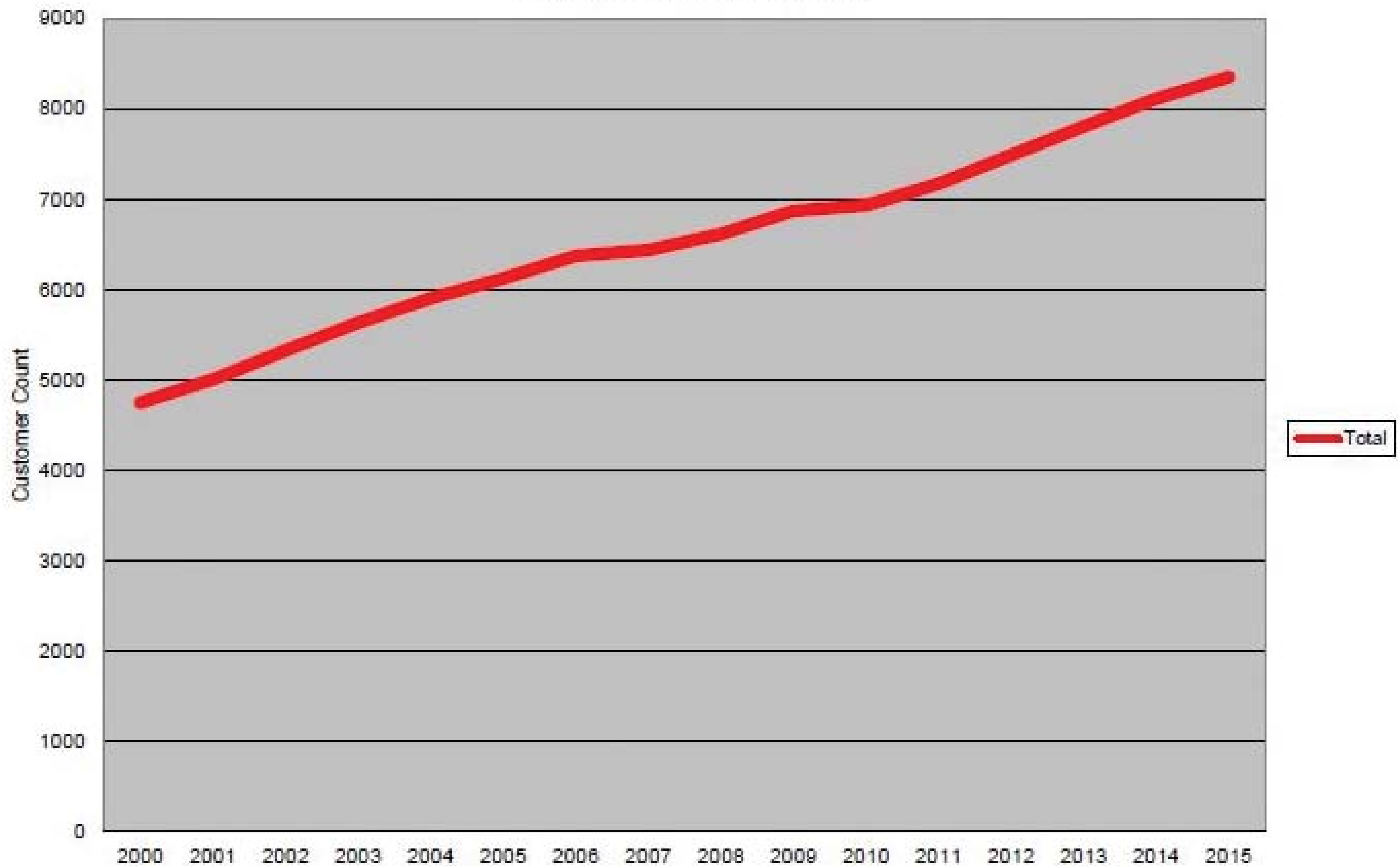
Dependent on Union Gas System

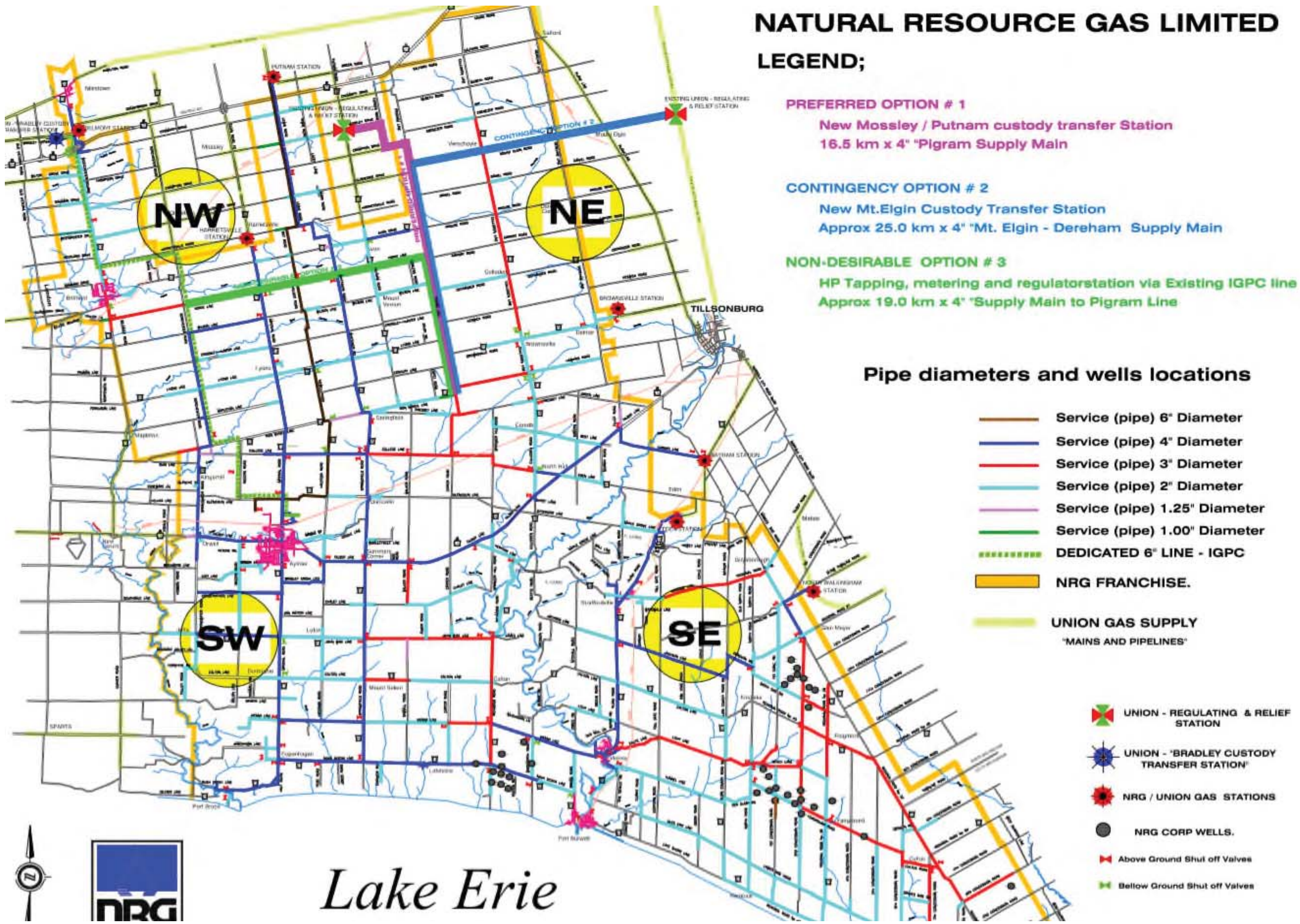
Distribution	
Retail Customers:	1.4 million
Annual Throughput:	537 PJ
Distribution Pipe:	107,000+ km
Transmission	
Annual Throughput:	867 PJ
Transmission Pipe:	4,743 km
Markets Served:	Ontario, Quebec, US Northeast
Dawn Storage	
Storage:	173 PJ
Underground Facilities:	23
Markets Served:	Ontario, Quebec, Marketers, US



Natural Resource Gas Ltd

Natural Gas Customer Growth





NATURAL RESOURCE GAS LIMITED
LEGEND;
PREFERRED OPTION # 1
New Mossley / Putnam custody transfer Station
16.5 km x 4" "Pigram Supply Main
CONTINGENCY OPTION # 2
New Mt.Elgin Custody Transfer Station
Approx 25.0 km x 4" "Mt. Elgin - Dereham Supply Main
NON-DESIRABLE OPTION # 3
HP Tapping, metering and regulatorstation via Existing IGPC line
Approx 19.0 km x 4" "Supply Main to Pigram Line
Pipe diameters and wells locations
Service (pipe) 6" Diameter
Service (pipe) 4" Diameter
Service (pipe) 3" Diameter
Service (pipe) 2" Diameter
Service (pipe) 1.25" Diameter
Service (pipe) 1.00" Diameter
DEDICATED 6" LINE - IGPC
NRG FRANCHISE.
UNION GAS SUPPLY
"MAINS AND PIPELINES"
UNION - REGULATING & RELIEF STATION
UNION - "BRADLEY CUSTODY TRANSFER STATION"
NRG / UNION GAS STATIONS
NRG CORP WELLS.
Above Ground Shut off Valves
Bellow Ground Shut off Valves
NW
NE
SW
SE
TILLSONBURG
Lake Erie
NRG

Refer to Handout

Ontario Energy Board
P.O. Box 2319
27th Floor
2300 Yonge Street
Toronto ON M4P 1E4
Telephone: 416- 481-1967
Facsimile: 416- 440-7656
Toll free: 1-888-632-6273

Commission de l'énergie de l'Ontario
C.P. 2319
27e étage
2300, rue Yonge
Toronto ON M4P 1E4
Téléphone: 416- 481-1967
Télécopieur: 416- 440-7656
Numéro sans frais: 1-888-632-6273

Ontario

BY E-MAIL

BY: EMAIL AND WEB POSTING

February 18, 2015

To: All Applicants and Potential Applicants for Expansion of Natural Gas Distribution

Re: Expansion of Natural Gas Distribution

The Provincial Government has set out a goal of ensuring that Ontario consumers in communities that currently do not have access to natural gas are able to share in affordable supplies of natural gas. In an effort to facilitate enhanced access to natural gas for rural and remote communities and businesses in the province, the Ontario Energy Board (the "Board") is inviting parties with the appropriate financial and technical expertise to propose one or more plans for natural gas expansion.

In this context and depending on the nature and scope of any proposals made, the Board is aware that regulatory flexibility may be required. The Board will hear requests for regulatory flexibility or appropriate exemptions in the context of an application made for approvals pertaining to expansion portfolios and specific projects.

Background

In the Long Term Energy Plan the Ontario Government signaled that it would look at opportunities to expand natural gas service within the Province to areas that are not currently served. In support of this objective, the Government, through the Minister of Economic Development, Employment and Infrastructure, will be making available;

- $200 million in Natural Gas Access Loans over two years to help communities partner with utilities to extend access to natural gas, and
- $30 million in "Natural Gas Economic Development Grants" to accelerate projects with clear economic development potential.

Refer to handout

TOWNSHIP OF SOUTH - WEST OXFORD

R. R. # 1, Mount Elgin, On. N0J 1N0
312915 Dereham Line
Phone: (519) 877-2702; (519) 485-0477; Fax: (519) 485-2932

Thursday, April 30, 2015

File: A20

Brian Lippold
General Manager
Natural Resources Gas Ltd.
39 Beech St. E
Aylmer, ON N5H 3J6

Dear Mr. Lippold:

Expression of Interest for Natural Gas for Township Residents

The Township of South-West Oxford is very interested in the extension of natural gas services to residents/businesses in our Township.

The Township of South-West Oxford has an Energy Conservation Committee that has identified Natural Gas as a service that would reduce our resident's dependency of electric, oil and propane powered furnaces. Natural gas would also offer them flexibility for their appliances and business needs.

Please accept this letter as our expression of interest to have natural gas servicing extended into the Township of South-West Oxford.

This would provide a much more cost effective way for our residents to service their utility needs.

Thank you.

Mary Ellen Greb, CAO

Refer to handout

April 24, 2015

NRG

Dear Home or Business Owner:

Re: Natural Gas

The Ontario Government has recently communicated a commitment to growing Natural Gas infrastructures within our province. The Ontario Energy Board is open to hearing proposals from Natural Gas Utility in efforts to expand into areas that were previously not economically viable by traditional economic models.

To assist NRG in providing service to your home or your business, we need to hear from you. Your expressions of interest will be presented as part of our case to expand current infrastructure into your area. Any communication must be in writing and must outline your perceived benefit(s) or reason(s) for converting to Natural Gas.

Please address letters to: Natural Resource Gas Ltd.
39 Beech St. E
Aylmer, ON N5H 3J6
Attention: General Manager

Or email to: Brian@nrgas.on.ca

Natural Gas is the only source of energy that has declined in cost over the past decade. It is not only cleaner and more convenient than other fossil fuels, it is abundant. In fact, experts agree that there is over 400 years of available natural gas deposits throughout North America. This will ensure that natural gas will continue to be price-predictable and affordable.

If you have any further questions, please do not hesitate to contact Bob Nesbitt at 519-773-5321 Ext. #209 or Brian Lippold, Ext. #205. You may also visit us on the web at **www.nrgas.ca.**

We look forward to hearing from you.

Warmest Regards,

B Lippold

Brian Lippold
General Manager,
Natural Resource Gas Limited,

THIS IS EXHIBIT "I" REFERRED TO IN THE AFFIDAVIT OF BRIAN LIPPOLD SWORN ON DECEMBER 4, 2019.

Commissioner for Taking Affidavits

DANIEL S. J. BANGARTH
Barrister, Solicitor, Notary Public
562 Waterloo Street
London, Ontario N6B 2P9
Ph (519) 472 2340 | Fax (519) 657 8173

EXHIBIT "I"

RESULTS OF EBO 188 GUIDELINES PROFITABILITY INDEX (PI) TEST FOR THE PUTNAM TO CULLODEN PIPELINE AND ENABLED LINES

1. This Exhibit provides details regarding the extent to which the ENGLP preferred route alternative, the Putnam to Culloden pipeline, facilitated future growth on the distribution system, defraying the costs of this system integrity project. The methodology used adheres to the *"Ontario Energy Board Guidelines for Assessing and Reporting on Natural Gas System Expansion in Ontario"* (EBO 188 Guidelines) *and* the EBO 188 "Report of the Board" dated January 30, 1998.

Purpose

2. The Putnam to Culloden Pipeline project has facilitated a number of additional customer connections. Although the primary reason the project was undertaken was for system integrity purposes, the utility was aware of a number of customers that were looking to connect to the system in the area (see Exhibit "F" for examples) and the secondary benefit of supporting this growth in part factored into the utility's decision to ultimately implement this option.

3. This Profitability Index (PI) calculation is supportive of management's views and decisions in 2016 and by demonstrating that, in addition to resolving the system integrity issues in the Northeast of the system, this alternative resulted in the added benefit of facilitating unsubsidized growth on the system.

4. Per the EBO 188 Guidelines, a resulting PI calculation of 1.0 or greater means that existing customers will not suffer a rate increase over the long term as a result of distribution system expansion.[1] That is, a new non-system integrity project, e.g. for a system expansion, which conveys no other secondary benefits to customers would be expected to deliver a PI of 1.0 or better, and a PI greater than zero and less than 1.0 demonstrates revenues which serve to partially defray the costs of a system integrity investment which would otherwise result in incrementally higher rates for customers.

[1] E.B.O. 188 Final Report of the Board, dated January 30, 1998, at paragraph 2.1.5

Introduction

5. The Putnam to Culloden line was preferred by NRG to the SNC Study alternative because it was the most effective means of diverting gas supplies from the Putnam Station to areas in the Northeast near Brownsville. Secondary to this function, the pipeline also facilitated future customer growth in the Northeast which the SNC Study alternative would not have provided.

6. The Putnam to Culloden Line made three significant additional projects possible by providing a source of gas supply:

- In 2017, a 2" pipeline along Salford Road from Culloden Line to Dereham Line
- In 2017 a 2" pipeline along Prouse Road from Culloden Line to Dereham Line
- In 2018, a 2" pipeline along Dereham Line from Salford Road to Prouse Road

7. These significant additional projects are referred to in this Exhibit as the "Enabled Lines", and shown in Figure 1 below for clarity.

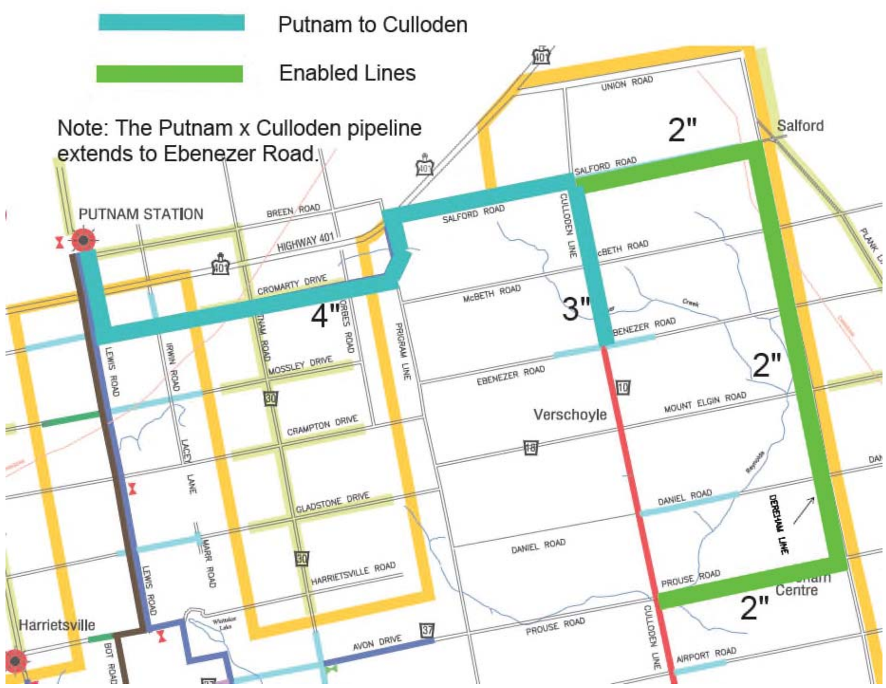


Figure 1 – Northeast area of NRG's Distribution System showing pipeline routes emanating from Putnam Station via Cromarty Drive, Pigram Line, Salford Road, Culloden Line, Dereham Line, and Prouse Road.

Result and Conclusions

8. The result of the EBO 188 system expansion PI test yields a PI of **0.68**. A large proportion of actual customers connected lie immediately along or a short distance from the Putnam to Culloden Line (which route includes Cromarty Drive and Pigram Road) or on 2" pipeline along Salford Road from Culloden Line to Dereham Line completed in 2017.

Table 1 – Immediate Customer attachments to the Putnam to Culloden Pipeline

Area	**Total Customer Count**	**High volume customers (Commercial or Industrial)**
Salford Road (west of Culloden Line)[2]	13	4
Culloden Line	9	3
Pigram Road	5	0
Cromarty Drive	2	0
Total	**29**	**7**

PI Calculation Assumptions, Inputs and Methodology

Capital Costs:

9. The Putnam to Culloden Pipeline costs as well as the costs of the Enabled Lines in the Northeast of ENGLP's system, were considered in 2016 when computing the PI of the system expansion. These costs are described in Table 2 noting the in-service year.

Table 2 – Significant pipeline costs

Pipeline Asset	**in-service year**	**Cost (in year of expenditure dollars)**
Putnam to Culloden Pipeline	2016	$570,000
2-inch Pipeline along Salford Road from Culloden Line to Dereham Line	2017	$101,099[3]
2-inch Pipeline along Prouse Road, from Culloden Line to Dereham Line	2017	$100,296[4]

[2] There are 10 further customers, including two Rate 1 industrial customers on the 2017 extension, a 2" pipeline along Salford Road from Culloden Line to Dereham Line.
[3] EB-2018-0336, response to interrogatory 1-VECC-1 (Phase 2)
[4] EB-2018-0336, response to interrogatory 1-VECC-1 (Phase 2)

2-inch Pipeline along Dereham Line from Salford Road to Prouse Line	2018	$250,390[5]

10. The project's capital cost is estimated to be $976,499(2016), inclusive of offsetting effects of capital contributions.

Costs of installing individual service connections:

11. With respect to service connections to the Putnam to Culloden Line and the Enabled Lines, ENGLP has assumed an average present value (revenue less costs for service connections) of **$334** per connection. This captures the costs of individual services, meters, regulators, less customary Miscellaneous Charges[6].

Customer Attachments and Revenues:

12. The project revenue horizon is 40 years.

13. Table 3 outlines actual customer attachments directly attributable to the Putnam to Culloden Pipeline and Enabled Lines.

[5] EB-2018-0336, response to interrogatory 1-VECC-1 (Phase 2)
[6] EB-2018-0336, Decision and Interim Rate Order, dated July 4, 2019, Schedule B, at page 14

Table 3 – Customer attachments directly attributable to the Putnam to Culloden Pipeline (included attachments from other enabled lines

Year	**Attachments Rate 1 residential**	**Attachments Rate 1 – Commercial**	**Attachments Rate 1 – Industrial**	**Total Number of Attachments**	**Total Additional Annual volumes (m3)**
2016	14	6	0	20	122,098
2017	7	0	1	8	29,063
2018	26	1	1	28	125,833
2019	11	0	1	12	41,627
2020[7]	0	0	1	1	67,770
TOTAL	**58**	**7**	**4**	**69**	**386,391**

14. Forecast growth of 2.75% is considered from January 1, 2020 onwards and reflects a 10-year customer attachment horizon, consistent with the EBO 188 Guidelines.

15. Customer attachments to the lines are a combination of actuals from November 2016 in-service to November 30, 2019, and forecast customer growth through to December 31, 2026 results in 83 total customers and volumes of 513,529 m3 for the purposes of the PI test.

Revenues:

16. The PI calculation uses rates that were in effect in 2016, 2017, and 2018 (per EB-2010-0018) and 2019 (IRM filings), as well as using the interim rates approved on July 4, 2019 inclusive of the Putnam to Culloden and Springwater pipeline from 2020 to 2024. These rates are used to compute revenues to be received from customers over a 40-year horizon. This includes application of the NRG/ENGLP’s tiered rate structure in respect to distribution volumes.

17. Monthly customer charges and customer volumes were pro-rated for each customer based on the number of months that each customer was connected in the year of attachment.

[7] One Rate 1 industrial customer connection was completed on November 29, 2019, but included from January 1, 2020. At the time of initial confirmation of information from ENGLP Aylmer Operations the meter had not been set. Accordingly, for the purposes of the analysis customer charges and volumes are not included in the model prior to January 1, 2020.

Discount rate:

18. The Board's prescribed weighted average cost of capital for January 1, 2016 was used to determine a discount rate for the 40-year time horizon. A capital structure of 40% equity, 56% long term debt, and 4% short term debt was used. At the effective tax rate of 26.5%, this results in a discount rate of 5.59%.

Incremental O&M costs:

19. Incremental O&M has been considered in the analysis. These costs include those for gas costs, billing, meter reading, inspection and maintenance, and customer calls.

Summary

20. Absent the benefits of system integrity, the Putnam to Culloden and Enabled Lines have a PI of 0.68.

21. A summary table of parameters and key results is provided at Table 4 on the following page.

Table 4 - Putnam to Culloden and Enabled Lines
Parameters and Key Results

Line No.	Col. 1 Description	Col. 2
EBO 188	PARAMETERS	
1.	Discount Rate	5.59%
2.	CCA Rate	6.00%
3.	Tax Rate	26.50%
4.	Customer Revenue Horizon (Years)	40.00%
5.	Annual Volumes (m3)	513,529
6.	Annual Distribution Revenues (Dollars)	148,466
7.	Annual O&M (Dollars)	(16,258)
8.	Capital Investment (Dollars)	1,003,040
	Working Capital	nil
EBO 188	RESULTS	
9.	Net Present Value	(318,531)
10.	Profitability Index	0.68